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BEING

FIGURES AND DESCRIPTIONS OF THE ORGANIC REMAINS PROCURED DURING
THE PROGRESS OF THE GEOLOGICAL SURVEY OF INDIA.

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Ser. XIII. SALT-RANGE FOSSILS,

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I. PRODUCTUS-LIMESTONE FOSSILS:

iv. (fas. 4.) BRACHIOPODA.

WITH PLATES LVIII—LXXXI.

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Family: *PRODUCTIDÆ.*

This is one of the oldest families that has been distinguished among the *Brachiopoda*, it having been founded as far back as 1816 by King; and since that time it has not undergone very great changes. Most authors have agreed in one point regarding this family, that is, to place it at the end of the *Arthropomata*, just before the *Lyopomata*; and its position in the system seems to be more certain than that of any other family of Brachiopods.

Its characters are very easy to be framed. The most striking one of all is the existence of reniform prominent ridges on the inside of the dorsal valve, a character which, in this strong and distinct development, is entirely restricted to the *Productidæ*. The nature of these ridges has been much disputed, and must be considered even now as an open question. Davidson and others were of opinion that these strange organs, in which the impressions surrounded by the ridge were taken to be the essential feature ("reniform impressions"), belonged to the vascular system, and were to be considered as strangely developed vascular impressions. In opposition to this view, the opinion was propounded by Keyserling, M'Coy, and Howse, that the prominent ridges had to be taken as the essential feature in these organs, and that these ridges served for the support of the brachial apparatus. This latter opinion has been taken up most recently by Neumayr (Neu. Jahrb. f. Min., 1883, Vol. II, p. 27); and in an able discussion he tried to prove that these organs had to be considered as brachial ridges. I must confess that I fully concur with him in all his deductions, and that I myself very strongly incline to accept Professor Neumayr's opinion; nevertheless I cannot deny that it would be very desirable that some additional proofs should be adduced, before this opinion can be considered as entirely well founded. These proofs should be deduced from a careful morphological study of the species of *Strophomena* and allied genera, in which the development of the brachial apparatus on the one hand in the direction of the *Productidæ*, and on the other hand in the direction of *Tropidoleptus* and the *Terebratulidæ*, must have taken place. I have not, at present, either the time or the materials to enter into such tudies; but for the present, after Professor Neumayr's publication, it seems to me far preferable to designate these strange organs of the *Productidæ* as brachial ridges than to continue to call them "reniform impressions," as, indeed, it is not the impression which is the essential part of the organ, but the surrounding elevated ridge.

A passage in Professor Neumayr's paper, which is of very great importance, I must quote here more in detail. He says, a chief objection of Davidson's against the opinion that these ridges form part of the brachial apparatus is the existence of spiral impressions which are to be found in the ventral valve of some specimens of *Productus*, and which beyond any doubt are impressions of the spirally enrolled arms of the animal. Now, as these impressions show not the slightest accordance with the brachial ridges, Mr. Davidson concludes that these latter cannot be taken as belonging to the brachial apparatus. "I cannot concur," says Professor Neumayr, "in this argument. The greater number of the now living Brachiopods have arms showing a double curve; and if such were, as is probable, present in *Productus*, these features (the ridges in the one and the spiral impressions in the other valve) are in no way difficult to explain; on the contrary, they indicate very accurately the direction and the manner in which the arms extended in ***Productus***. They ran first along the descending, then along the re-ascending branch of the ridges, were then bent back over the descending branch and curled in a spiral coil. which caused the impression in the ventral valve Thus, in their general shape, these arms very nearly agree with those occurring in *Terebratula* and *Waldheimia*, though in proportion and direction of the different parts certain differences exist." This deduction is of very great systematic importance.

Another very characteristic feature of the *Productidæ* consists in the cardinal process of the dorsal valve, which is mostly long and thickened at its extremity. It is generally tripartite at its upper or exterior face, and bipartite on the lower or interior one.

The ventral valve shows no very characteristic features. In ***Productus*** and some allied genera the valve is entirely devoid of cardinal teeth, whilst in ***Chonetes*** and ***Strophalosia*** such teeth are present. The presence or absence of these teeth can very well be made use of for the distinction of two sub-families within the *Productidæ*, of which one may bear the name *Chonetinæ*, whilst the other has to receive the name *Productinæ*.

Sub-Family: *CHONETINÆ.*

This sub-family comprises those forms which have cardinal teeth developed in the ventral valve. In connection with this character is the very general occurrence of an area in the ventral valve and a pseudodeltidium in the middle of it. None of the muscular impressions is dentritic. The greater part of the forms belonging to this sub-family are free, but some, the *Strophalosiæ*, have been fixed to foreign bodies either only in the young stage, or during the whole lifetime. One species, a *Strophalosia*, has lived parasitic in the interior of corals.

The following genera belong to this sub-family :—

1. Chonetes, Fisch. v. Waldheim, 1837. Oryct. Gouv. de Moscou, II, p. 134, pl. 26, f. 8, 9.

This genus is characterised by a long straight hinge-line and a narrow area in the ventral valve, marked off from the remainder of the shell by sharp edges, which are ornamented with a row of projecting spines. All the species are free, not sessile. Silurian to permian. (For particulars of the genus see Oehlert: **Bull.**

Soc. Géol. de France, 3rd sér., t. XI, p, 513; T. Young, Geol. Mag. Dec. II, Vol. X, p. 368; and Davidson, *ibid.*, p. 371.)

2. **Strophalosia**, King, 1844. Ann. and Mag. Nat. Hist., Vol. XIV, p. 313.

Hinge-line short; an area mostly in both valves, the margins of which are *not* provided with a row of spines. Most of the species are sessile during their younger stages of growth, or during their whole lifetime. (Devonian ?) Permian.

3. Chonetella, Waagen, n. gen.

This genus holds about the middle place between *Chonetes* and *Productus*. The cardinal teeth are rudimentary. In both valves an area is mostly present, the upper margins of which, in the ventral valve, are ornamented with spines. The brachial ridges form the commencement of a spiral. (?) Permian (Salt-range).

4. Daviesiella, Waagen, n. gen.

I create this genus for the reception of such forms as *Productus Llangollensis*, Dav., and *Prod. comoides*, Sow., which are characterised by cardinal teeth and a second pair of adductor impressions in the ventral valve. The other characters are like those of *Productus*. Mountain-limestone.

Sub-family: *PRODUCTINÆ.*

This is composed entirely of forms in which the ventral valve is without cardinal teeth, and in which the impressions of the adductor muscles are dendritic. The shells that belong to this sub-family attain far more considerable dimensions than those of the preceding sub-family, and some of the species are among the largest forms that occur in the *Brachiopoda*. Nearly all the shells of species belonging to this sub-family are free during their whole lifetime, and were not even fixed by a pedicle to foreign bodies. Only in the genus *Productus* some few species occur, which were fastened either by the entire ventral valve or by spines that project from that valve and creep root-like along corals, the stems of crinoids, or similar objects.

The genera belonging to this sub-family are the following:—

5. **Aulosteges**, Helmersen, 1847; Neu. Jahrb. f. Min., p. 330.

The hinge-line of these shells is long; the ventral valve has a large and high area, with a not very large pseudodeltidium in the middle. The interior of the dorsal valve is characteristic. Permian.

6. **Productella**, Hall, 1867; Pal. New York, Vol. IV, p. 153.

Hinge-line tolerably long, denticulated; ventral valve with area. Devonian.—(?) Carboniferous (Prod. sinuatus, Kon. ?)

7. **Productus**, Sowerby, 1812; Min. Conch, I., p. 153, pl. 68., IV, p. 15, pl. 317.

Hinge-line tolerably long, smooth, not denticulated. Ventral valve very rarely with a linear area. Internally the valves of the well-known construction. Carboniferous, permian.

8. **Marginifera**, Waagen, n. gen.

Shell externally very much like *Productus*. Internally a thickened shelly margin extends parallel to and at a certain distance from the edge of both valves, thus causing a partition to be formed within the shell (see Pl. LXXVII, fig 6). Carboniferous (?) to permian.

It appears from this list that the number of generic divisions in each sub-family is not very large, but so much the larger is the number of species within the single genus. The sub-family *Chonetinæ* begins already in the silurian period and extends up into the permian, whilst the *Productinæ* start from the devonian and terminate also in the permian formation.

In the Salt-range not less than six of the eight genera above enumerated are represented; they are: *Chonetes, Strophalosia, Chonetella, Aulosteges, Productus*, and *Marginifera*.

Sub-family: *CHONETINÆ.*

Genus: CHONETES, Fisch. v. Waldh.

This genus has been long recognised and very generally accepted. It is in general very easily recognisable by the regular shape, the long and straight hinge-line, and a narrow area in the ventral valve of the shells belonging to it. The area is generally ornamented along its upper margin with prominent spines. On a first glance the species of *Chonetes* can be distinguished from *Productus* by a much less strongly curved ventral valve and an apex which is not at all bent over. Though this external shape is retained by the greater number of species, yet there are exceptions. There are chiefly some forms in which the spines on the upper margins of the area are not developed. It might be that in these shells, if better preserved specimens were obtainable, such spines would be detected; but in one species from the Salt-range at least it seems highly probable that the shell never possessed such spines. In other cases the shell of *Chonetes* becomes strongly vaulted, the apex much bent over and even enrolled; and then the area under the beak becomes much concealed and the similarity to *Productus* very great.

In the interior the shells of *Chonetes* are very characteristic. In the ventral valve there are small hinge-teeth on both sides of the pseudodeltidium. The muscular impressions are mostly not very distinct, and only the adductor impressions can be well seen on both sides of a raised middle line or kind of low septum. Immediately adjoining these are large oval impressions, apparently partly muscular and partly perhaps ovarial impressions. The interior of the dorsal valve shows a small impressed or hollowed out cardinal process on both sides of which the dental sockets are situated. The muscular impressions as well as the brachial ridges are in all the species of the Salt-range at least very distinct; the latter are generally speaking rather more hook-shaped than reniform.

The dentoid muscular impressions, characteristic for all the genera of the subfamily *Productinæ*, are absolutely absent in the genus *Chonetes*.

The genus is very largely represented in the Salt-range, and some beds are filled with thousands of individuals of a single species. Not less numerous, however, than the individuals are the species, and I am able to distinguish not less than 14. When one considers that in all the formations beginning from the silurian up to the permian only about 60 species are known up to the present, the number of 14 in the beds of the Salt-range must really be taken as enormous. Also, the variation of form is much greater in these species than has been known up to the present in the genus *Chonetes*. Mons. de Koninck has distinguished five sections within the genus, *viz.*: I. *Concentricæ*, with concentric plications; II. *Comatæ*, with more than 100 smooth radial folds; III. *Striatæ*, with less than 100 but more than 30 smooth radial folds; IV. *Plicosæ*, with less than 30 smooth radial folds; and V. *Rugosæ*, with rugose radial folds. Of these groups I should think the second and third, the *Comatæ* and the *Striatæ*, should be united, as their distinction is entirely artificial, and on a first glance it is impossible to distinguish between the two divisions. The divisions, however, should be based on such external characters as would make the distinction of the single forms possible on a first glance. Thus we have for the present four divisions: I. *Concentricæ*, II. *Striatæ*, III. *Plicosæ*, and IV. *Rugosæ*. Of these four groups, only one is represented in the Salt-range—this is the *Striatæ*; but only three of the species occurring there can be placed in this group, and all the others belong to groups of forms which were not known at the time of publication of Mons. de Koninck's work. One further division has already been introduced by Davidson for the reception of *Chonetes polita*, M'Coy, and for which he created the name of "*Læves*." This division is largely represented in the Salt-range, and I count five species that belong to it. Nevertheless, there remain six more species which cannot be brought under any of the divisions hitherto adduced. They compose one more division, which contains the forms with very strong and high radiating ribs, and for which I shall introduce the designation of "*Grandicostatæ*." Thus we have got in the Salt-range three divisions of the genus *Chonetes*, *viz.*, I. *Læves*, II. *Striatæ*, and III. *Grandicostatæ*.

As regards the section *Læves*, the forms occurring in the Salt-range can be considered as forming two groups. One of them is represented by *Chonetes ambiensis*, W., a species which might perhaps be identical with *Chonetes rotundatus*, Toula., from permo-carboniferous beds of Spitzbergen, but which could not be identified on account of Toula's exceedingly bad figure. This species seems to be very nearly related to *Chonetes polita*, M'Coy, and both forms must be considered as belonging to one and the same group, which I shall call "Group of *Chonetes polita*, M'Coy." The remaining four species of the Læves are all more or less nearly related to each other, and form together one group which seems to have taken its origin from *Chonetes glabra*, Gein. (*non* Hall.), of the permo-carboniferous beds of Nebrasca. The name of the latter species having been preoccupied by Hall, I introduce for it the name of *Chonetes geinitziana*, W., and shall call this group "Group of *Chonetes geinitziana*, W."

The division "*Striatæ*" is but sparingly represented in the Salt-range, but yet the species occurring there can be distributed into three groups. There is one species, flat and finely striated, which I shall call *Chonetes squama*, W., and which seems to be most nearly related to and as belonging to the "Group of *Chonetes papilionacea*, Phill."

Another species, for which I shall introduce the name of *Chon. strophomenoides*, W., is most nearly related to the typical *Chon. variolata*, Orb., which I consider as entirely different from *Chon. variolata*, Kon. (*non* Orb.) or *Chon. granulifera*, Owen. This species will thus belong to the "Group of *Chon. variolata*, Orb." The third species of the *Striatæ* will bear the name of *Chon. compressa*, W.; it is bipartite, and thus more or less nearly related to *Chon. variolata*, Kon. (*non* Orb.) and different from *Chon. laguessiana*, Kon. (=*Chon. hardrensis*, Phill., Dav.). What name ought to be applied to Koninck's *Chon. variolata* is difficult to decide; perhaps the name of *Chon. vishnu*, Salt., which was introduced for a carboniferous species of the Himalaya, could be made use of, or else *Chon. flemingi*, Norw. and Pratt; provisionally I shall call this group "Group of *Chon. vishnu*, Salt."

The section *Grandicostatæ* is, as far as is known up to the present, entirely restricted to India. The six species occurring in the Salt-range belong to two different groups. The first of these is more or less nearly related to *Chon. austeniana*, Dav., from Kashmir, and two species can be distinguished within it: *Chon. semiovalis*, W., and *Chon. dichotoma*, W. The second group seems to be rather nearly related to a shell which has been described by Davidson also from Kashmir under the name of *Spirifer barusiensis*. To this group belong *Chon. squamulifera*, W., *Chon. deplanata*, W., *Chon. grandicosta*, W., and *Chon. aequicosta*, W.

Thus we arrive at the following grouping of the species of *Chonetes*:—

I.—Section LÆVES.

a.—Group of CHONETES POLITA, M'Coy.

1.—*Chonetes ambiensis*, Waagen, n. sp.

b.—Group of CHONETES GEINITZIANA, Waagen, n. sp.

2.—*Chonetes morahensis*, Waagen, n. sp.
3.— „ *avicula*, Waagen, n. sp.
4.— „ *trapezoidalis*, Waagen, n. sp.
5.— „ *bipartita*, Waagen, n. sp.

II.—Section: STRIATÆ.

c.—Group of CHONETES PAPILIONACEA, Phill.

6.—*Chonetes squama*, Waagen, n. sp.

d.—Group of CHONETES VARIOLATA, Orb.

7.—*Chonetes strophomenoides*, Waagen, n. sp.

e.—Group of CHONETES VISHNU, Salt.

8.—*Chonetes compressa*, Waagen, n. sp.

III.—Section: GRANDICOSTATÆ.

f.—Group of CHONETES AUSTENIANA, Davidson.

9.—*Chonetes semiovalis*, Waagen, n. sp.
10.— „ *dichotoma*, Waagen, n. sp.

g.—Group of CHONETES BARUSIENSIS, Davidson, sp.

11.—*Chonetes squamulifera*, Waagen, n. sp.
12.— „ *deplanata*, Waagen, n. sp.
13.— „ *grandicosta*, Waagen, n. sp.
14.— „ *æquicosta*, Waagen, n. sp.

With regard to the apparition in time of the different species, it must be noted that the lower Productus-limestone has furnished but a single species: *Chon. ambiensis.* This seems to be very nearly related to the coal-measure species *Chon. rotundata*, Toula., whilst the latter stands in close connection to *Chon. polita*, M'Coy, from the mountain-limestone. It is beyond doubt a developmental series, which is here before us, *Chon. lævis*, Dav., from carboniferous deposits of the Himalaya might perhaps be identical with *Chon. rotundata*, Toula. All the other species of the Salt-range occur in the middle and upper divisions of the Productus-limestone. The group of *Chon. geinitziana* stands in very close relation to that American coal-measure species, and *Chon. morahensis*, W., is the form that approaches nearest that species, and is at the same time the geologically oldest form of the group that occurs in the Salt-range. All the other forms of this group have been found in the upper Productus-limestone, but a developmental connection between any of these forms and *Chon. geinitziana*, or of the forms among each other can barely be established.

All the species belonging to the section *Striatæ* occur in the middle Productus-limestone. It is very probable that the single forms stand in a developmental connection with the typical species of the respective groups in which they have been placed.

The two groups of forms that compose the section *Grandicostatæ* can be traced with great probability from two Himalayan shells. The one group from *Chonetes austeniana*, Dav., the other from a shell that has been described by Davidson under the name of *Spir. Barusiensis.* Mr. Davidson had only a single valve of the latter at his disposal, and thus the error, that he considered this as the dorsal valve of a *Spirifer,* can easily be explained, no shell to which it could have been compared being known at the time. *Spir. barusiensis* shows, however, such a typical resemblance to the largely costate *Chonetes* of the Salt-range, that I am convinced that the shell from Kashmir is also a *Chonetes.*

The group of *Chon. austeniana* is restricted in the Salt-range to the middle division of the Productus-limestone, whilst the group of *Chon. barusiensis* has representatives in the middle as well as in the upper divisions.

I.—SECTION: LAEVES.

a.—GROUP OF *CHONETES POLITA*, M'Coy.

1. CHONETES AMBIENSIS, Waagen, n. sp., Pl. LVIII, figs. 1—6.

This little species is about semi-circular in its outline, the hinge-line being as long or a little longer than the greatest breadth of the remainder of the shell. The ventral valve is very strongly inflated, and the dorsal one just as much concave. On each side of the apex along the margin of the area of the ventral valve, mostly three, sometimes four spines are situated.

The ventral valve is, as has been said above, very strongly vaulted, and its curve is very equal and regular in both directions, only the apical region is slightly more strongly inflated than the rest of the valve, thus allowing the wings to appear slightly flattened towards both ends of the hinge-line. The apex is barely prominent, but distinctly bent over. The hinge-line is quite straight, and generally marks the greatest breadth of the shell, only rarely is the greatest breadth situated a little lower down. Between the hinge-line and the apex extends a long but narrow area, which is sometimes concave, sometimes not. It is ornamented with striæ of growth parallel to the hinge-line. In the middle there is a very large and broad triangular fissure, which is only at its upper extremity filled up by a small and short vaulted pseudodeltidium, which is, however, easily lost. On the very sharp margins of the area, which descend from the apex to both ends of the hinge-line, three to four very thin spines are situated on each side; they are, however, in none of the specimens entirely preserved.

The surface of the valve is entirely smooth, only very faint striæ of growth can be distinguished, but no large punctures.

The dorsal valve is sometimes more, sometimes less, concave, chiefly towards the middle region of the valve, but the wings in the vicinity of both ends of the hinge-line are almost always considerably flattened. Along the straight hinge-line a narrow but very distinct area is developed, which turns its face somewhat towards the observer. In the middle there is a thick, oval, prominent knob, which bears an excavated line in the middle, and fills the deltidial fissure of the other valve; it is the external continuation of the cardinal process. This valve is also entirely smooth, with only some more strongly marked imbricating striæ of growth; nor are any larger punctures observable in it.

The internal characters of both valves are well known to me. In the ventral valve there are on both sides of the cardinal fissure small but distinct hinge-teeth, which are not supported by septa. At the upper end of the same fissure a distinct septum commences, which is highest and bifid at its upper termination, then tapers quickly and changes into a low ridge, and in this form it extends nearly half way down to the front of the valve. Not far from its upper termination two narrow, elongated deep impressions are situated, which are probably the scars of the adductors, and outside of these two very large roundish impressions can be discerned, very likely the scars of the divaricators. The whole arrangement of these impressions shows a very great similarity to the same organs in *Chonetes hardrensis* as figured by Davidson. The whole remaining interior surface of the valve is covered by rather coarse granulations, which are arranged in indistinct radial rows.

The dorsal valve has a broadly compressed, not very prominent, cardinal process, on both sides of which the dental sockets are situated. Both pairs of adductor impressions are very distinct. Between the two pairs on each side the brachial ridges take their origin. They descend in a gentle curve to more than half way from the front-margin, and then bend round towards the middle line, forming nearly a semi-circle. The middle line is not raised but excavated. The whole surface of this valve, except the muscular impressions, is covered by a rather coarse granulation, which is tolerably distinctly arranged in radial rows.

The measurements of the largest specimen known to me are as follow:—

Entire length of the shell	9	mm.
Length of the ventral valve	8	„
Entire breadth of the shell	11	„
Length of the hinge-line	10	„
Entire thickness of the shell	3·5	„
Distance of the two valves from each other	2·5	„
Apical angle of the ventral valve	146°	

There exists some variation among different individuals as to comparative breadth of the shell and length of the hinge-line, the inflation of the ventral valve, and so on, but the variation is never great.

Locality and geological position.—This species is restricted to the lower division of the Productus-limestone, but there is only one locality where it occurs in great numbers and fills a whole bed with thousands of individuals, the *Chonetes* bed, as I have already quoted it several times. This locality is below the village of of the ventral valve which is broader and less deep, whereby it arises that the two folds which extend from the apex diverge at an angle of about 70°, whilst the angle enclosed between them is only 21°—22° in the species hereunder consideration.

Thus, though it is highly probable that there exists a certain developmental connection between the two forms, yet it seems necessary to distinguish the Indian shell under a proper specific designation.

I know of no other species which could be more closely compared to the present one.

3. Chonetes avicula, Waagen, n. sp., Pl. LIX., fig. 5.

This is a middle-sized species of a nearly rectangular or squarish outline, having a slightly vaulted ventral and a concave dorsal valve, the former with two radiating folds. The margins of the shell are not in one plane as in other species, but the lateral parts are depressed, and the frontal part bent up in the direction of the ventral valve, as it appears on the drawing, Pl. LIX., fig. 5f.

The ventral valve is nearly flat, and very little vaulted. Its curve is regular, but very small in the longitudinal direction. The curve is somewhat more considerable in the transverse direction, but here restricted to the median part of the shell, whilst the lateral parts, chiefly in the vicinity of the hinge-line, are considerably flattened. The apex of the valve is barely prominent, not pointed and not bent over. The area is comparatively large and strongly reclining, cut open in the middle by a not very large triangular fissure, which is perfectly filled up by the cardinal process of the other valve. A pseudodeltidium cannot be distinguished. The very sharp margins, by which the area is limited off from the other face of the valve, are ornamented by three spines on each side of the apex, but in the majority of specimens every trace of these spines has been destroyed. From the apex down to the front extend two strongly prominent rounded folds, which have a tolerably deep sinus between them. Outside of these folds the valve is depressed and bent down, so that the lateral margins make a gentle wave downward in the direction of the dorsal valve. The front margin on the contrary is again bent up in the direction of the ventral valve, notwithstanding the sinuation which it bears in the middle.

The dorsal valve is concave and follows in every particular the curve of the opposite valve. The apex is not at all prominent but also hollowed out. The valve bears a narrow but distinct area, which is interrupted in the middle by a prominent knob, the outward continuation of the cardinal process. The valve shows in the middle a not very prominent, broad, rounded fold, which is limited on both sides by not very broad rounded furrows. The lateral parts are strongly bent up, and flattened only near the hinge-line. In some specimens it appears as if a sculpturing of some few radiating lines were present, but these are very faint and barely visible even with a lens.

The interior structure of this species is not known to me. The surface of the shell is entirely smooth, and even the imbricating striæ of growth are scarce and faint. Larger punctures seem to be present, but are very indistinct.

The measurements of a specimen from Khura are as follows:—

Entire length of the shell	7·5 mm.
Length of the dorsal valve	7 „
Entire breadth of the shell	10 „
Length of the hinge-line	8·5 „
Entire thickness of the shell	3 „
Distance of the valves from each other	1 „
Apical angle of the ventral valve	155°
Divergence of the two folds on the ventral valve	30°

Locality and geological position.—This species has been found by me at a single locality,—this was in the section near Khura, where it occurred not very rarely in the upper division of the Productus-limestone. I procured there four specimens, all duplicates.

Remarks.—The present species is again more or less nearly related to *Chon. geinitziana* and the species previously described. From both it can be well distinguished by its nearly squarish outline and the undulating shell margin.

There is no other species known to me to which the present one could be more particularly compared.

4. CHONETES TRAPEZOIDALIS, Waagen, n. sp., Pl. LIX., figs. 3, 4.

Of this rather small species only ventral valves are known to me. They present a more or less trapezoidal outline, the greatest breadth of the shell being marked by the hinge-line. From the apex to the front-line there extend two strongly prominent and strongly diverging folds. The frontal margin is strongly indented.

The ventral valve is tolerably strongly vaulted, chiefly in the longitudinal direction. Its curve is regular, and the greatest inflation is situated about the middle of the valve. Transversely the curve is less strong, and at the same time less regular: the lateral parts are distinctly flattened, whilst the middle is considerably elevated. The apex is somewhat prominent, bent over and pointed. The area is not clearly visible and cannot be entirely cleaned on account of the smallness of the specimens and the hardness of the rock in which they are contained. As far as it can be made out, the area seems to be tolerably large, flat, only a little concave towards the apex, and cut open in the middle by a tolerably large deltidial fissure. The very sharp upper margins of the area are ornamented with three spines on each side of the apex. These spines are always broken off. The surface of the valve appears very distinctly characterised by the two very strong diverging folds extending from the apex to the frontal margin. Between them there is a deep and very broad sinus, whilst outside there are other not very high or distinct radial folds. They are three to four in number. The margins of the valve are all in one plane, and the frontal margin shows a deep sinuation.

The surface of the valve is apparently entirely smooth, and only very faint striæ of growth can be observed. The preservation of the surface is not sufficiently clear to allow it to be stated whether larger punctures were present or not.

The dorsal valve of this species is not known to me.

The largest specimen that has been observed up to the present shows the following measurements:—

Entire length of the shell	6 mm.
„ breadth of the shell	10 „
„ thickness of the shell	2 „
Apical angle of the ventral valve	122°
Divergence of the two folds	52°

Locality and geological position.—I detected this species in the same slab of sandstone, coming from the upper Productus-limestone of Morah, in which *Chonetes morahensis* was contained in great numbers. The present species is, however, very much rarer than the other one; for whilst the slab contained a great number of specimens of *Chonetes morahensis*, I detected not more than two specimens of the present species in it.

Remarks.—The form here under consideration seems to be most nearly related to the species with which it is associated, this is *Chon. morahensis.* The differences from that species consist in the trapezoidal outline, in the broader median sinus of the ventral valve, and the greater divergence of the two prominent folds, and in the smaller number of species along the margins of the area.

Chon. geinitziana is yet more widely different from the present species than *Chon. morahensis.*

5. CHONETES BIPARTITA, Waagen, n. sp., Pl. LIX., figs. 1, 2.

This is a comparatively large species, with a transversely oval outline, having a slightly inflated ventral and a concave dorsal valve, with a longitudinal angular impression along the middle of the ventral valve.

The ventral valve is rather flat, only a little vaulted. The curve is very regular in the longitudinal direction, but less so transversely, where the lateral parts of the valve are considerably flattened. The apex is very prominent, pointed, and distinctly bent over. It overhangs a tolerably broad vertical area, which is a little concave, and cut open in the middle by a very large deltidial fissure. The surface of the valve is ornamented with two broad rounded folds or protuberances, separated from each other by a very narrow sinus, which appears almost as if cut in with a knife. The sinus commences only at a certain distance from the apex. The condition of preservation of the only ventral valve that exists in the Salt-range collection is such that it remains doubtful whether the sharp edges limiting the area were ornamented with spines or not. It appears to me as if there were points of insertion of eight spines on each side of the apex, but I cannot be certain on the point.

The surface of the valve is perfectly smooth, with the exception of some imbricating striæ of growth, which are, however, not very distinct. With the lens a great number of larger punctures, which seem to be rather irregularly disseminated, can be seen. The interior of the ventral valve is not known to me.

The dorsal valve is almost entirely flat and only very slightly concave. In the middle it bears a narrow prominent longitudinal fold. The external side is, however, in the specimens at my disposal, nearly quite covered up by rock-matter, and it is chiefly the internal side which is well preserved. The cardinal process is prominent, conical, and flattened on the interior side: interiorly at its origin a distinct circular groove is excavated. The dental sockets on both sides of the process are long, narrow, and slit-like. The muscular impressions are very distinct. The outer and larger pair of adductors forms large reniform impressions in deep grooves below the dental sockets. The smaller pair is situated on a slightly raised platform, on both sides of a low septum originating between these impressions, and extending a short distance towards the front. The brachial ridges are low but distinct: they originate at the lower margin of the larger pair of muscular impressions, and turn in a gentle curve round towards the septum. The granulation, which is a prominent feature in other species of *Chonetes*, is but little developed in this one, though it is not entirely absent as would appear from the figure.

The measurements of a ventral valve from Khund-Ghat are as follows :-

Entire length of the shell	12	mm
Height of the area	2	,,
Entire breadth of the shell	16	,,
Length of the hinge-line	12	,,
Entire thickness of the shell	4	,,
Apical angle of the ventral valve	120°	

Locality and geological position.—The species is very rare in the Salt-range, having only been found there up to the present at a single locality. It was Mr. Wynne who collected two specimens of it, one ventral and one dorsal valve, in the upper Productus-limestone of Khund-Ghat.

Remarks.—The present species seems to be further removed from the species described previously than the latter from each other. Nevertheless, I think also the present species can be added with safety to the group of *Chon. geinitziana*, like the others, but we must trace its relation not from *Chon. trapezoidalis*, but from *Chon. morahensis* Whilst the group of forms, to which *Chon. avicula* and *Chon. trapezoidalis* belong, is characterised by two radial folds, which become more and more apart from each other, *Chon. bipartita* is probably a member of another line of development, which also starts from *Chon. morahensis*, but in which on the contrary the two folds more and more approach each other.

Thus *Chon. morahensis* must be chiefly compared to the present species. It is easily distinguishable by its broader median sinus and different general outline.

II.—SECTION: STRIATÆ.

c.—GROUP OF *CHONETES PAPILIONACEA*, Phill.

6. CHONETES SQUAMA, Waagen, n. sp., Pl. LXI, figs. 1, 2, 3.

The shell here under consideration is of a middle size, quite flat, of a transversely oval or somewhat trapezoidal outline, with a very fine radial striation.

The ventral valve is quite flat, barely vaulted in any direction. The apex is not prominent and not incurved, the area is very narrow, nearly linear, and, as far as can be seen, devoid of spines along its upper margins. The deltidial fissure is small. The outside of this valve is, however, not known to me, as only one specimen, of which the inside only is exposed, is accessible to my observation. Small cardinal teeth are situated on both sides of the deltidial fissure. Along the median line from near the apex a narrow elongated impression extends for about one-third of the length of the valve, hemmed in on both sides by elevated ridges. It is somewhat broader at its upper end and gets narrower towards its lower termination. On either side of these ridges bordering the median impression large oval impressions extend; they are however rather flat and not very strongly marked. These large impressions are beyond doubt the divaricator scars, but whether the median impression is due to the adductors remains doubtful, as it is too narrow to distinguish whether it is longitudinally divided in two or not. The whole inside of the valve is, like the outer side, covered with a very fine radial striation; and one can count considerably more than one hundred striæ along the margin of the valve. But while the striæ on the outside of the valve are smooth, those on the inside are finely papillate, which is only visible with a very powerful lens. The striæ augment more often by bifurcation than by intercalation.

The dorsal valve is also nearly quite flat, and only in the apical region is it a little impressed. It has a distinct linear area, which in the middle is interrupted by a slightly prominent knob, the external continuation of the cardinal process. The surface of the valve is covered by very numerous radiating striæ which augment mostly by bifurcation. If examined with a powerful lens, they show exactly the same characters as have been figured of *Chon. papilionacea* by Mr. Davidson. When the outermost layer of the shell is well preserved, the same fine scaly striæ of growth and the same sparingly distributed round orifices on the top of the striæ are observable as in *Chon. papilionacea*. This outer shell layer is, however, preserved only in very few and small patches. The greater part of the specimens at my disposal are deprived of this outermost layer, and then between the single striæ rows of oval grooves appear, exactly as on the left side of Davidson's figure. These grooves are, however, not on the internal cast, but on the interior shell layer.

The interior side of the dorsal valve can be well seen on two specimens. The cardinal process is barely at all prominent, strongly excavated, lamellar and bent up. On both sides of it distinct dental sockets are situated. They are limited below by prominent, rounded ridges, which directly join the lateral parts of the cardinal process and separate the dental sockets from the impressions of the outer and upper pair of adductors. These latter are deep, very distinct, large and of an oval shape. Not far from the cardinal process a low median septum originates. It extends to not very far from the frontal margins. On both sides of this septum, not far from the cardinal process, two elongated grooves can be distinguished, which are evidently the scars of the interior pair of adductors. The brachial ridges are situated between the two pairs of adductor impressions, but they are very indistinct in this species; two oval slightly raised spaces can be distinguished, but the exact shape of the ridges cannot be stated. Except the muscular impressions, all the remaining inner surface of the valve is covered by a fine granulation which is distinctly arranged in radial rows.

The measurements of an isolated dorsal valve are as follow:—

Entire length of the shell	12	mm.
„ breadth of the shell	20	„
Length of the hinge-line	16	„
Entire thickness of the shell	1	„

The specimen of which the measurements have been given is the largest one known to me.

Locality and geological position.—The species occurs in a single piece of rock brought by Mr. Wynne from Katwáhi. The rock is much decomposed by weathering and consists of a fine yellowish-red ferruginous oolite, a rock which has never been found by me *in situ*. Also Mr. Wynne only found the fragment among the debris of the Productus-limestone. Probably the oolitic nature of this rock has only become visible through the action of weathering; and it appears highly probable that this piece came from the middle Productus-limestone. The lower Productus-limestone is not well developed in the vicinity of Katwáhi, and is there mostly represented by lavender-coloured clays. The upper Productus-limestone of the same region is entirely composed on the other hand of yellowish-gray sandstones, and thus there remains for this ferruginous oolitic limestone no other division but the middle one from which it probably came.

The piece of rock in question is entirely filled with the shells of this *Chonetes*, and no other species is contained in it.

Remarks.—Though the spines along the margins of the area have not been detected up to the present on the form here under consideration, yet I think it most probable that the species will have to be considered as a rather near ally of *Chon. papilionacea.*

I did not arrive immediately at this way of considering the matter, but for a long time was very much in doubt whether this shell should not rather be transferred to the genus *Strophomena*. After a long deliberation, however, I thought it most prudent to consider the shell as a *Chonetes*, as the interior characters, though not quite identical with other species of *Chonetes*, can yet be most naturally brought into accordance with that genus. After I had thus come to the conclusion that the present shell was a *Chonetes*, the most natural grouping seemed to be to class it with *Chon. papilionacea*, Phill., as this is the only species which is similarly finely striated and possesses similarly flat valves, and in which the minute sculpture is absolutely identical. Though *Chonetes squama*, W., thus seems to be most nearly allied to, yet it cannot be considered identical with Phillips's species. The chief differences consist in a shorter hinge-line and smaller area of the Indian shell. Also the internal characters seem to be different, but these are very imperfectly known in *Chon. papilionacea*.

Of other species, none can be compared more particularly to the present one.

d.—GROUP OF *CHONETES VARIOLATA*, Orb. (sens. strict.)

7. CHONETES STROPHOMENOIDES, Waagen, n. sp., Pl. LVIII, fig. 10.

This is a comparatively large species of somewhat transversely rectangular outline, the greatest breadth of the shell being at the hinge-line. The shell is but little inflated, and is provided in the middle with a broad but not very deep sinus.

The ventral valve is in some specimens rather flat, in others somewhat more inflated. The curve is in neither direction quite equal and regular. Longitudinally the shell appears rather flattened in the apical region, whilst not far from the front it bends more strongly down and shows, chiefly in some specimens, a rather bold curve. Transversely the curve is very regular in the middle region of the valve, and flattened only on the lateral parts, chiefly in the vicinity of the hinge-line where distinct wings are developed. The apex is not at all prominent, not pointed, and not bent over. The area is quite flat and narrow, cut open in the middle by a very small deltidial fissure. The very sharp margins that limit the area above are ornamented by four oblique spines on each side of the apex, which are, however, not visible on every specimen.

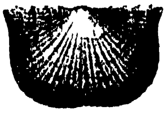

Fig 16, *Chonetes strophomenoides*, W., n sp., ventral valve with partly preserved marginal spines, natural size, from the lowest beds of the middle Productus-limestone of Swás.

The broad median sinus, which is developed on this valve, commences only at a short distance from the apex, and extends down to the front. The whole surface of the shell is covered by a fine radial plication, which augments mostly by bifurcation. On the margin of the valve one counts 8 to 10 striæ in the space of 5 mm., and thus 60 to 80 striæ on the whole valve. The spaces between the striæ are remarkable for the very large punctures they bear, which are easily visible to the naked eye on certain specimens. But some of these punctures are also disseminated on the top of the striæ.

The dorsal valve is flatly concave, with a slight prominent median fold and deepened spaces on each side of it. It is very nearly approximated to the ventral valve, and the space which remains between the two is very small; towards the margins the two valves are so firmly pressed against each other that they cannot at all be distinguished. The sculpture of this valve is somewhat different from that prevailing on the other valve, the radial striæ being rather coarser, less distinctly dichotomous and somewhat wavering in direction, which latter circumstance is caused by roundish grooves placed between the ribs causing a very indistinct barely perceptible concentric sculpture to be formed. The puncturing is less distinct in this than in the other valve.

Of the internal characters but little is known to me. In the ventral valve the cardinal teeth on both sides of the deltidial fissure can be tolerably well distinguished in one specimen, whilst in the same specimen it can be seen that the cardinal process of the dorsal valve is comparatively long and very narrow. Of the other internal characters nothing is known to me.

The measurements of a specimen from Swas are as follow:—

Entire length of the shell	13	mm.
Length of the dorsal valve	12	„
Entire breadth of the shell	22	„
Length of the hinge-line	24	„
Entire thickness of the shell	4	„
Distance of the valves from each other	1·5	„
Apical angle of the ventral valve	? 120°	

Locality and geological position.—This species was contained in a single piece of rock brought by Dr. Oldham from Swás. Three species of Brachiopoda were contained in this rock: *Chonetes compressa*, W., in very great numbers, the present species, somewhat less numerously, and one species of *Strophalosia*, in a few specimens. The rock is a very hard, sandy, somewhat micaceous limestone of a rusty colour, and comes beyond any doubt from the limits between the middle and upper division of the Productus-limestone.

Remarks.—The present species is without the slightest doubt most nearly related to *Chonetes variolata*, Orb., and I would be very much inclined to consider the two shells as identical; if not, according to d'Orbigny's drawing, the South American form would possess a finer and more regular radial striation than the specimens from the Salt-range. The coarse punctation, to which the name alludes, is equally well developed in the Indian and in the American shell. Thus *Chonetes strophomenoides*, W., will probably have to be considered as a representative form or geographical variation of *Chonetes variolata*, Orb.

Chonetes variolata, Kon. (*non* Orb.) is something entirely different, and cannot be compared with the present species.

Of other species, one form of the genus *Productus* must be taken into comparison, and this is *Productus sinuatus*, Kon., of which chiefly the dorsal view shows a certain similarity. The sculpture of the dorsal valve of *Productus sinuatus* and *Chonetes strophomenoides* is nearly identical, though the concentric sculpture is slightly more distinct in Koninck's species. Also the ventral valve has a small area in that species of *Productus*, but beyond this the similarity does not extend. The curvature of the ventral valve and the disposition and direction of the spines near the areal margin are entirely different, and there remains no doubt that the two forms must be considered as distinct, even if one were inclined to put the *Productus sinuatus* into the genus *Chonetes*.

c.—GROUP OF *CHONETES VISHNU*, Salter.

8. CHONETES COMPRESSA, Waagen, n. sp.

This is a rather small species, with very flat valves, which are so close together that scarcely any no room remains between them. The ventral valve bears in the middle a low sinus, and the radial striation of both valves is limited to the median parts, whilst the lateral parts remains entirely smooth.

Fig. 17. CHONETES COMPRESSA, Waagen, n. sp. Specimen from the lowest beds of the middle Productus-limestone of Swás: *a*. ventral valve, natural size; *b*. the same enlarged, *c*. dorsal view, natural size; *d*. the same enlarged.

The ventral valve is nearly quite flat, barely perceptibly vaulted, and appears very much like a fish's scale. Only the median part is slightly elevated, and in the middle again impressed, thus forming a broad but very flat sinus. The lateral parts are distinctly flattened and form well distinguishable wings, which are at the same time devoid of a radial striation. The apex is very little prominent, pointed and not bent over. Below it there extends a very narrow flat reclining area, interrupted in the middle by a narrow deltidial fissure. The margins which limit the area above are very sharp, but in none of the specimens at hand can the spines, which are probably situated on them, be distinguished. The hinge-line is long and straight, and marks the greatest breadth of the shell. The sinus does not commence immediately on the apex but a little distance from it; but immediately at the apex commences the fine radial striation of the shell, which is very characteristic in this species and which covers the sinus and the elevated parts of the shell adjoining it, but is absent on the lateral wings. The striation is extremely fine, and there are four to six striæ in the space of one millimeter. The single striæ are distinctly swollen from distance to distance, where rather thick spines are placed on them, which follow approximately the direction of the shell surface, pointing towards the margin of the shell. These spines were hollow tubes, as can be distinctly seen on their broken ends, but none of them is completely preserved on any of the specimens at hand. These spines were largest and thickest just in the centre of the valve, and from there both towards the apex and the margins of the valve they rapidly diminish in size.

The dorsal valve is very flatly concave, the apex not prominent, with a linear area along the straight hinge-line. From the apex, comparatively strong prominent folds start towards the lateral margins, thus marking off the lateral wings. The space between these two folds is most deeply impressed, whilst the wings are rather flattened. In the vicinity of the frontal margin a very slightly indicated median fold can be distinguished. The sculpture consists also in this valve of a fine radial striation, but it is in every respect the reverse from that of the other valve. Where there are striæ in the other valve are furrows in this one, and instead of the spines of the other valve we find deep grooves disseminated along the furrows.

Of the internal characters of this species nothing is known to me.

The measurements of two specimens, No. I, a duplicate, and No. II, a ventral valve only, are as follows:—

	I.	II.
Entire length of the shell	6 mm.	6·5 mm.
Length of the dorsal valve	5·5 „	?
Entire breadth of the shell (along the hinge-line) . . .	10 „	11 „
„ thickness of the shell	1 „	1 „
Distance of the two valves from each other	0·5 „	?

Locality and geographical position.—This species was present in great numbers in the same slab of rusty sandy limestone which contained the specimens of *Chonetes strophomenoides*, W., described previously. It must also be considered as coming from the lowest part of the middle division of the Productus-limestone.

Remarks.—This species belongs to a group of forms for which no proper name is available, though the geologically oldest form of the group is very well known to palæontologists. In the mountain-limestone the group of the devonian *Chonetes hardrensis*, Phill., begins to be split up into two series of forms, one with a median sinus in the ventral valve, the ancestor of the form here under consideration, and another without such a sinus: *Chon. Laguessiana*, Kon. and allies. In the mountain-limestone proper, it must be admitted, this splitting up is not yet perfect, and the form with a sinus just begins to appear; but later on the sinuated forms become of very great importance and in the coal-measures are by far predominating. Starting from such considerations it seems to be strongly desirable to have a proper specific name for the form in the mountain-limestone in which a sinus is well developed, and which has been so excellently figured by Count Keyserling in the Geology of Russia, or by Mons. de Koninck in his monograph of the genus *Chonetes*. Perhaps this form could be identified with *Chonetes vishnu*, Salt., from carboniferous beds of the Himalaya, and this name be adopted for it; or perhaps also *Chonetes flemingi*, Norw. and Pratt., could prove to be identical, though this comes from the upper Coal Measures of America.

That the sinuated form was not identical with *Chonetes variolata*, Orb., as was formerly advocated, has been admitted by Koninck himself in his monograph of the fossils from Bleiberg.

The species described here under the name of *Chonetes compressa*, W., is very easily distinguishable from all the sinuated forms that have been described up to the present, by its smooth wings and the comparatively large spines that are clustered together in the centre of the ventral valve.

III.—SECTION: GRANDICOSTATÆ.

f.—GROUP OF *CHONETES AUSTENIANA*, Dav.

9. CHONETES SEMIOVALIS, Waagen, n. sp., Pl. LXI., fig. 5.

In its general characters the present species still approaches very nearly the "*Striatæ*," as besides the larger plications of the shell a very fine barely perceptible radial striation also exists. The outline of the shell is transversely oval, the hinge-line being shorter than the greatest breadth of the shell. The ventral valve bears a not very broad median sinus.

The ventral valve is but little inflated, very regularly and equally vaulted in both directions, only the lateral parts are slightly flattened in the vicinity of the hinge-line. The apex is slightly prominent, pointed and strongly bent over. The area is rather narrow, flat and slightly concave in the middle. The deltidial fissure is very large. The upper margins of the area are very sharp and ornamented with seven spines on each side of the apex. The median sinus of the valve commences at the very extremity of the apex. It is not very broad, but rather deeply sunk in and rounded in its depth, not sharply cut in. It is bordered on both sides by high, broad, rounded folds. Otherwise the sculpture of the shell consists of numerous, not very high rounded radiating costæ, which are often dichotomous, and rather unequal in strength, there being six within the sinus and about eight on each lateral part. All over the valve there are disseminated a very great number of large punctures which can be seen even with the naked eye. They are arranged irregularly in radial rows, the arrangement causing the formation of a very fine radial striation which is very characteristic for this species.

On the whole, however, the sculpture is somewhat variable. The radial plications, which I have described above, become sometimes very weak and barely distinguishable, so that the sculpture of the valve then only consists of the median sinus and the high folds on both sides of it. But even then the species can easily be recognised by the large punctures and the fine radial striation that is produced by them.

The dorsal valve of this species is not known to me, and nothing could be observed also of the internal characters of the species.

The measurements of a specimen from Morah are as follow :—

Entire length of the shell	13 mm.
Length of the dorsal valve	11 „
Entire breadth of the shell	18 „
Length of the hinge-line	16 „
Entire thickness of the shell	5 „
Apical angle of the ventral valve without the wings	114°

Locality and geological position.—The species is not very rare in the middle Productus-limestone of Morah, where it occurs associated with *Chonetes morahensis.* Some four specimens from there are known to me. Another specimen was collected by myself at Khura in the topmost beds of the middle Productus-limestone, and one specimen was brought by Mr. Wynne from Khund Ghat, but the exact bed it came from is not known.

Remarks.—The present species is very nearly related to *Chonetes austeniana,* Dav., and on a first glance one might consider both identical, but on a close comparison some difference can be traced, which makes a distinction of the two desirable. In the species from Kashmir the hinge-line is comparatively longer, the radial plications fewer and broader, and the median sinus of the ventral valve narrower than in the Salt-range species. Also the fine radial striation, which is so very characteristic in *Chonetes semiovalis,* seems to be absent in *Chonetes austeniana,* Dav. It thus seems to me perfectly justifiable to distinguish the two specifically.

Another form to which the present species seems to be very nearly related is *Chonetes morahensis,* W., which has been described above. In this form, however, the radial plication, as well as the fine radial striation, is not developed to the same extent as in *Chonetes semiovalis:* the general outline is also very different, it being well rounded in *Chonetes semiovalis* and nearly trapezoidal in *Chonetes morahensis.* It needs only a comparison of the figures of the two species to see these differences.

10.—CHONETES DICHOTOMA, Waagen, n. sp., Pl. LXI., fig. 4.

This is a middle-sized species of transversely trapezoidal outline, having a hinge-margin which occupies the greatest breadth of the shell, and a but little inflated ventral valve. This latter bears a broad median sinus and fine radial plications which show a distinct bundling.

The ventral valve is not strongly arched, but its curve is somewhat more considerable in the longitudinal than in the transverse direction; chiefly the lateral parts in the vicinity of the hinge-line are considerably flattened, thus forming a kind of wings. The apex is little prominent, pointed and well bent over: it overhangs a distinct narrow area which is entirely flat, not concave, and is cut open in the middle by a not very large deltidial fissure; along its upper very sharp margins it is ornamented by about five spines on each side of the apex. Of the spines, however, only the roots are preserved. Immediately at the apex of the valve there begins a broad sinus, which is deepest and broadest in the vicinity of the front. It is limited on both sides by broadly rounded prominences. Besides this sculpturing the valve is covered all over by a fine radial plication, which is simple within the sinus and on the flattened lateral wings, and distinctly bundled on the prominences that border the sinus on both sides. There are about six such fine plications within the sinus, and about as many on each lateral wing; on each prominence, however, three broad bundles can be distinguished, each of which is composed of two to three ribs. Concentric striæ of growth cross over these radial plications but they are very faint.

The dorsal valve is not deeply but very equally concave, and only the lateral parts in the vicinity of the hinge-line are considerably flattened, forming distinct wings. There is a very distinct narrow area, quite straight, and interrupted in the middle by a thick cardinal process. This valve also is covered by a fine radial striation, which becomes coarser in the deep excavations corresponding to the prominences of the other valve.

The minute structure of the shell in this species shows also a great many large punctures, arranged indistinctly in radial rows.

Of the internal characters of this specie nothing is known to me.

The measurements of a specimen from Katwáhi are as follow:—

Entire length of the shell	11	mm.
Length of the dorsal valve	10	„
Entire breadth of the shell (at the hinge-line)	16	„
„ thickness of the shell	5	„
Distance of both valves from each other	3	„
Apical angle of the ventral valve, without the wings	82°	

Locality and geological position.—The only specimen of this species that is known to me was collected by Mr. Wynne at Katwáhi, but the bed it came from is not exactly known. From the preservation of the specimen it appears probable that it came from the middle division of the Productus-limestone.

Remarks.—The present species is very nearly related to the preceding one and can be distinguished chiefly by its different general outline, the broader sinus of the ventral valve and the absence of the fine radial striation, characteristic for the preceding species.

The present species agrees pretty well with *Chon. austeniana* in its general outline, but it has a much broader median sinus and a fine radial plication which is absent in Davidson's species. Thus it seems that the shell here under consideration represents a well distinguishable form which deserves a proper specific designation.

g.—GROUP OF *CHONETES BARUSIENSIS*, Dav., sp.

CHONETES SQUAMULIFERA, Waagen, n. sp., Pl. LX., figs. 1—4.

This species is of a middle size and somewhat trapezoidal outline, the greatest breadth of the shell being situated at the hinge-line. The ventral valve is rather strongly inflated, provided with a very broad sinus, and ornamented with strong radiating folds which are never dichotomous.

The ventral valve is very equally curved, chiefly in the longitudinal direction. Transversally it appears flattened or impressed in the middle, and the lateral parts are distinctly flattened, forming small triangular wings. The apex is prominent, pointed, and strongly bent over. It overhangs a broad slightly concave area, which is cut open in the middle by a very large deltidial fissure. The upper sharp margins of the area are provided with four spines on each side of the apex. The very broad sinus of this valve begins immediately at the apex, which appears in consequence somewhat flattened. It is limited on both sides by highly elevated broadly rounded folds, which also commence at the apex. On these general features of sculpture the radial plication is distributed. Within the sinus are generally about six rather fine folds, whilst on the elevated parts of the shell, on both sides of the sinus, three very strong and thick folds follow, which are again succeeded by much smaller ones on the lateral wings. These latter are, however, often very indistinct or even entirely absent.

The minute surface sculpture of this valve is very peculiar. Under the lens, the whole surface appears as if covered with very small scales, which are very irregularly arranged and directed not towards the shell margin, but upwards towards the apex of the valve. These scales seem to be in a certain connection with the striæ of growth, and are probably a strange modification of them; though observed in most specimens, they are not always developed in the same degree, and it seems that this circumstance depends upon the more or less complete preservation of the shell surface. If the shell is somewhat worn by weathering, the large punctures which occur on most species of *Chonetes*, appear also in this one in great numbers. They are sometimes indistinctly arranged in radial rows. In this species they were evidently *not* in connection with hair-like spines on the shell surface.

Of the internal characters of the ventral valve nothing can be observed, except the existence of two well developed cardinal teeth, which are fastened to the hinge-line on both sides of the deltidial fissure.

The dorsal valve can be but rarely observed. It is rather deeply concave and in every respect the reverse of the other valve; it bears two deep excavations where the elevated folds are on the other valve, and each elevated radial plication of the ventral valve is here represented by a more or less deepened radial furrow. The lateral wings are flattened and slightly hollowed out. The valve is provided with a very distinct narrow area, which is interrupted in the middle by a strong cardinal process.

In the only specimen of the dorsal valve with its outer side accessible to observation, I cannot observe the fine scales with which the other valve is covered; but the large punctures, which seem to be somewhat more scarce than on the other valve and are arranged very regularly in radial rows, are very distinctly visible.

The inner side of the dorsal valve is most beautifully exposed in a specimen from Jabi. The cardinal process is short and little prominent, and at the sides of it the dental sockets are situated. It is somewhat excavated on its inner side. The two pairs of adductor impressions are very distinct. The outer pair is large, oval, and situated in deep grooves, which are limited on both sides by comparatively high folds. The inner pair is much smaller, narrowly elongated, and very deeply impressed, rather far apart. A short but well developed septum originates at the lower extremity of these latter impressions. The brachial ridges are large but very faint, and encircle an oval space. Nearly the entire inner surface is covered with irregularly disseminated little spines.

The measurements of the largest specimen known to me from Jabi (No. I) and of a somewhat smaller specimen from Khura (No. II) are as follow :—

	I.	II.
Entire length of the shell	10·5 mm.	8 mm.
Length of the dorsal valve	8·5 „	7 „
Entire breadth of the shell	15 „	12 „
„ thickness of the shell	5·5 „	1·5 „
Distance of the two valves from each other	2	2 „
Apical angle of the ventral valve, without the wings	76°	83°

and geological position.—This is one of the more common species of *Chonetes* occurring in the Salt-range, and it extends through the middle and upper divisions of the Productus-limestone.

In the lower region of the middle division the species has been found by myself in the section at Khura (two specimens), and in the same section two specimens were detected by me in the top beds of the middle division. At Káfirkot, trans-Indus, the species is tolerably common in the middle region of the middle division; I collected there five specimens, whilst Mr. Wynne, at a spot somewhat north of my locality, obtained five specimens more.

In the upper division, I found the species west of Khura; in the lower region of the division (seven specimens), and in the upper region in the Cephalopoda bed of Jabi (five specimens).

Remarks.—If *Spirifer barusiensis*, Dav., might really be considered as the ventral valve of a *Chonetes*, then the present species would be very nearly related to Davidson's form. Nevertheless I would not consider the two shells as specifically identical. The form from the Himalaya is just twice as broad as it is long, and the lateral wings are very large and pointed; while, as regards size the whole shell is considerably smaller. In *Chonetes squamulifera* on the contrary, the length is never less than two-thirds of the breadth, the wings are much smaller and less pointed, and it attains a much more considerable size. Thus I think the two shells must be considered as belonging to two different species.

Another species for comparison is *Productus robertianus*, Kon., from permian beds of Spitzbergen. As the dorsal face of this shell is not known, the possibility of its being a *Chonetes* is yet an open question. In the description, Mons. de

Koninck compares this species also to the ventral valve of a *Spirifer*. It can, however, be easily distinguished from our *Chonetes squamulifera* by its smooth and narrow sinus and its bifurcating ribs.

Of other forms, I do not know any which could be compared more closely with the present species.

12. CHONETES DEPLANATA, Waagen, n. sp., Pl. LX., figs. 5, 6.

This species is very nearly related to the preceding one, and differs from it chiefly by its strongly flattened valves and the occurrence of dichotomous ribs.

The ventral valve is but very little vaulted in every direction. Its curve is very regular longitudinally, but transversely the valve appears impressed in the middle by the presence of a very broad sinus, and the lateral parts form rather large flattened wings. The apex is slightly prominent, pointed, and but little bent over. The area is tolerably large and flat, cut open in the middle by a large deltidial fissure. Along its upper very sharp margins, three spines can be observed on each side of the apex. The hinge-line is somewhat longer than in the preceding species, and thus the lateral wings are more prominent and more strongly pointed. The deep and broad median sinus of the valve commences directly at the apex. There are three to four fine radial ribs within the sinus. On both sides of the sinus the shell forms highly prominent broad folds, each of which is ornamented by three, mostly dichotomous, strong radial ribs. The minute sculpture of the shell is squamose or scaly as in the preceding species.

The dorsal valve bears a very distinct narrow area and is flatly concave, forming in every detail the reverse of the other valve. This valve is not sufficiently well preserved for observation of its minute surface sculpture.

Of the interior characters of this species nothing is known to me.

The measurements of a specimen from Káfirkot are as follow :—

Entire length of the shell	9	mm.
Length of the dorsal valve	8	,,
Entire breadth of the shell (at the hinge-line)	12	,,
,, thickness of the shell	3·5	,,
Distance of the two valves from each other	2	,,
Apical angle of the ventral valve	147°	
,, ,, ,, ,, ,, without the wings	85°	

Locality and geological position.—There are altogether only two specimens of this species known to me, both which were collected by myself at Káfirkot in the middle division of the Productus-limestone.

Remarks.—It is not easy to distinguish the present species from the preceding one, and it was chiefly the great flatness of the valves and the often dichotomous ribs, which led me to distinguish specifically between the two forms. These differences, just pointed out, will most easily be detected in comparing the frontal apical and lateral views of the different specimens figured on Pl. LX. Also the more considerable length of the hinge-line is a feature which may serve for characterising the present species.

In this latter character, however, it approaches again more closely to *Chon.* (*? Spirifer*) *barusiensis*, Dav., and yet the hinge-line of my *Chon. deplanata* is considerably shorter in comparison to the length of the shell than is the case with Davidson's species. Otherwise, the shell from Kashmir seems to be also more inflated than *Chonetes deplanata*.

13. CHONETES GRANDICOSTA, Waagen, n. sp., Pl. LXI., figs. 6, 7.

Among all the species belonging to this group the present is the one which is most extremely developed in all its characters.

The shell is very strongly inflated and enrolled, the sinus very deep and broad, the wings small and pointed, and the whole surface covered by very strong radiating folds.

The ventral valve is most strongly inflated, and exhibits in the longitudinal direction a strong parabolical curve. The apex is pointed, slightly prominent, and extremely bent over, so much so that the very broad area is entirely concealed under the upper sharp areal margins, while the area forms an angle of about 90° with the plane of the valve. The deltidial fissure is very large. On the sharp upper margins of the area, the points of insertion of three (perhaps four) spines on each side of the apex can be observed. The very deep and broad sinus commences immediately at the apex, and occupies in its breadth nearly half of the entire surface of the valve: it is limited on both sides by extremely prominent rounded folds, which occupy the remaining space of the valve with the exception of the small pointed wings. Besides these general features of sculpture; the whole valve is covered by a radial plication, which is rather fine within the sinus and extremely strong on the elevated folds that border it on both sides. Within the sinus there are between five or six ribs, and on the elevated folds there are again five very strong and elevated ribs on each side. The wings are smooth and devoid of a radial plication. This radial sculpture is crossed from distance to distance by fine slightly imbricating striæ of growth. Between these, if the surface of the shell is very well preserved, a fine scaly structure can be observed. If, however, the shell is only very slightly weather-worn, large punctures appear, which are arranged irregularly in radial rows.

The dorsal valve of this species is not known to me.

Also nothing could be observed of the interior characters of this species.

The measurements of two specimens are as follow:—

	I	II
Entire length of the shell	11 mm.	10·5 mm.
Breadth of the area	?	2 „
Entire breadth of the shell at the hinge-line	14 „	14 „
Breadth of the deltidial fissure	?	2 „
Entire thickness of the shell	8 „	6 „
Apical angle of the ventral valve, without the wings . .	71°	81°

Locality and geological position.—There are only three specimens of this species known to me, all three of which were collected by myself in the cephalopoda bed of the upper Productus-limestone at Jabi.

Remarks.—This species is very peculiar in all its characters, and it can be very easily recognised. Though it is more or less nearly related to all the species that have been described above of the same group of forms, yet it is very easily distinguishable, and the differences are so obvious that it seems hardly necessary to point them out in detail.

14. CHONETES ÆQUICOSTA, Waagen, n. sp., Pl. LX., fig. 7.

This shell is considerably smaller than all those previously described of the same group, except *Spir. barusiensis*, Dav., which is nearly of the same size.

It is about as broad as it is long, of a slightly trapezoidal outline, well vaulted, with a narrow sinus and a very regular fine radial plication.

The ventral valve is rather strongly inflated, but its curve is not quite regular, being stronger in the apical than in the frontal region. The apex is pointed, slightly prominent, and very strongly incurved. The area is inclined under the apex and entirly concealed; it is also covered up by rocky matter in the two specimens at my disposal. The sharp margins which limit the area above are, however, well exposed, and seem to bear traces of two to three spines on each side of the apex. The sinus begins at the very extremity of the apex, but is narrow and not very deep: it is limited on both sides by low, broad, rounded folds, which are followed again by the small, flattened and pointed wings. The whole valve is covered by a very equal radial plication which is not quite correctly represented in the figures on Pl. LX. There are four to five folds within the sinus, which are of very equal size; then follow two slightly stronger ones on the top of the lateral folds; and then again about eight somewhat finer ones, which still cover part of the wings. That part of the wing, however, immediately adjoining the areal margin is smooth.

The minute sculpture of the valve is smooth, not scaly; and the larger punctures seem to be scarce, but are not very distinct.

Neither the dorsal valve nor the interior characters of the species are known to me.

The measurements of a specimen from Jabi are as follow :—

Entire length of the shell	7	mm.
„ breadth of the shell at the hinge line	9	„
„ thickness of the shell	3	„
Apical angle without the wings	100°	

Locality and geological position.—There are altogether only two specimens known to me both of which were collected by myself at Jabi in the cephalopoda-bed of the upper Productus-limestone.

Remarks.—On a first glance, it seems to be nearly obvious that the present species is only the young of the preceding one, and that it is quite superfluous to make a new name for the present form. For a long time I held this opinion, and it was only after a closer comparison that I found it not practicable to unite the two forms. *Chon. æquicosta* has a differently curved ventral valve, the apex is more strongly incurved, and the remainder more flattened, the sinus is narrower and less deep and the radial plication more equal. Also the minute sculpture of the shell is different. These differences would not exist if the present shell were only the young of *Chon. grandicosta,* and thus I came to the conclusion that we had to deal with a different and smaller species.

The present species very nearly agrees in size with *Spir. barusiensis,* Dav., but the proportions are quite different. Whilst *Spir. barusiensis* is just twice as broad as it is long, in *Chon. æquicosta* the length and breadth are nearly identical.

Of other species none can be compared more closely to the present one.

Genus: STROPHALOSIA, King.

The characters of this genus are very easily recognisable, particularly if one has to deal with quite typical species. The well developed, very distinct area in both valves, the always deformed apex of the ventral valve, produced by the circumstance that it has been fixed to foreign bodies, and the consequently always more or less irregular shape of the whole shell, are the very striking characters which make a recognition of the shells belonging to the genus very easy. Internally, the presence of cardinal teeth is very important, but not so striking, as these teeth can only be rarely observed. Of equal importance are the absence of dentritic muscular impressions and the circumstance that the interior pair of adductor-scars in the dorsal valve is always strongly raised.

These characters are all developed in a typical manner in the species of *Strophalosia* that occur in the permian formation, but as soon as we turn to forms from other beds, it seems difficult to re-detect all these characters. King quotes two species from the devonian and one from the mountain-limestone, which he considers to belong to the genus *Strophalosia.* One of the devonian species, *Strophalosia subaculeata,* Murch., has in the meantime by Hall been made the type of his genus *Productella,* and it is doubtful if the other should not be considered as belonging to the same genus. The carboniferous *Strophalosia buchiana,* Kon., sp., seems to possess a very small area as it has been entirely overlooked by Mons. de Koninck, who figures the shell without a trace of it. Thus this species also seems at least not to be a typical form of *Strophalosia,* and so there remains only the permian species having the striking external appearance of the genus. To these has been added a truly carboniferous species, *Strophalosia cornelliana,* by Derby, who detected this shell in the upper carboniferous beds of the River Tapajos in Brazil.

In the permian beds of Europe about six species of *Strophalosia* have been detected up to the present, which all seem to belong to approximately the same group of forms, of which *Strophalosia goldfussi,* Munst. (*emend.* Geinitz), is the geologically oldest and may be considered as the typical species. To this group belong two shells occurring in the Salt-range, which are identical with European species: *Strophalosia excarata*, Gein., from the upper region of the middle Productus-limestone, and *Strophalosia horrescens*, Vern., from the lower region of the same division.

One species of *Strophalosia* has been already described by Davidson from the Salt-range under the name of *St. morrisiana*, King. *Var.* There can be no doubt at all that this shell is extremely similar to King's species, and if only two specimens are available, as was the case with Mr. Davidson's materials, it appears most natural to unite this shell with *St. morrisiana*. Nevertheless, after having studied extensive materials of this species most carefully, I have come to the conclusion that the Indian shells belong to a group of forms entirely different from *St. morrisiana*, which most probably replaces the *St. morrisiana* in southern countries, and of which *St. cornelliana*, Derby, must be considered as the prototype. This group is represented in the Salt-range by two species: *St. varispina*, W., in the middle, and *St. indica*, W., in the cephalopoda-bed of the upper division of the Productus-limestone.

A third group of forms is entirely restricted to the lower Productus-limestone. As the prototype of this group, most likely the *Strophalosia gerardi*, King, from Spiti can be considered. The group is represented by three species in the Salt-range: *Strophalosia plicosa*, W., *Strophalosia nodosa*, W., and *Strophalosia tenuispina*, W.

Lastly, there still remains a species which is again very nearly related to a European form: *Strophalosia leplayi*, Gein. (*non Productus leplayi*, Vern). The Indian shell cannot be directly identified with that species, but its near relation to the form from the "Weissliegenden" of Germany is all the same of great interest. This shell will bear the name of *Strophalosia costata*, W.

Thus we have altogether eight species of *Strophalosia* in the Salt-range, a number that exceeds by two the number of species occurring in the permian beds of Europe. This fact is, as it appears to me, of high geological importance, and gives to the Brachiopod-fauna of the Salt-range a very young geological or newer palæozoic aspect.

These eight species can be grouped, as has been indicated above, in the following manner:—

a.—Group of STROPHALOSIA GOLDFUSSI, Münst.

1.—*Strophalosia excarata*, Geinitz.
2.— „ *horrescens*, Vern.

b.—Group of STROPHALOSIA CORNELLIANA, Derby

3.—*Strophalosia varispina*, Waagen.
4.— „ *indica*, Waagen.

c.—Group of STROPHALOSIA GERARDI, King.

5.—*Strophalosia plicosa*, Waagen.
6.— „ *nodosa*, Waagen.
7.— „ *tenuispina*, Waagen.

d.—Group of Strophalosia leplayi, Gein.

8.—*Strophalosia costata*, Waagen.

a.—Group of *STROPHALOSIA GOLDFUSSI*, Münst.

1. Strophalosia excavata, Geinitz, Pl. LXV, fig. 5.

1842. *Orthis excavata*, Geinitz: Leonh. and Bronn's Jahrb., p. 578, Pl. X, figs. 12—13.
1848. *Orthothrix excavata*, Geinitz: Deutsch. Zechst., p. 14, Pl. V, figs. 35—40; Pl. VI, figs. 20—21.
1850. *Strophalosia goldfussi* (Munst.); *Strophalosia excavata* (Gein.); *Strophalosia parva* (King), King: Monogr. Perm. Foss, p. 96, 98, 102, Pl. XI, figs. 19, 20; Pl. XII, figs. 1—17, 33.
1857. *Strophalosia goldfussi* (Münst.), Davidson: Monogr. Brit. Perm. Brach., p. 39, Pl. III, figs. 1—18.
1861. *Strophalosia excavata*, Geinitz. Dyas, Vol. I, p. 93, Pl. XVII, figs. 1—19.

The materials of this species are very small, but the specimen is so characteristic that I think the determination can be made with sufficient accuracy.

The specimen which serves for description is of rather small size, broader than it is long, and distinguishable from all the other *Strophalosia* occurring in the Salt-range by the presence of a broad sinus in the middle of the ventral valve not far from the front.

The ventral valve is moderately inflated, of a broadly triangular outline, with a curve which is in the longitudinal direction strongest in the apical region. Transversely the valve appears somewhat flattened in the middle, whilst the sides bend strongly down. The hinge-line is short, much shorter than the greatest breadth of the shell. The area appears to be small but is covered with rocky matter. The apex is pointed, bent over, and flattened on the top, showing the place where the shell has been fixed to a foreign body during its youth. The sinus developed on this valve commences only at a certain distance from the apex about half way to the front. It is shallow but rather broad; and in this respect, as well as in many other characters, the Indian specimen resembles most that figured by Geinitz, Dyas, Pl. XVII, fig. 12. The whole valve is covered with little spines, which do not appear quite numerous enough on our figure, Pl. LXV., fig. 5, and which are arranged irregularly in quincunx: they are slightly finer and more numerous towards the margins than in the middle of the valve. Between these spines concentric striæ of growth can be observed.

The interior of the ventral valve as well as the dorsal valve are not known to me.

The measurements of the specimen are as follow:—

Entire length of the shell	14	mm.
„ breadth of the shell	16	„
Length of the hinge-line	8·5	„
Entire thickness of the shell	8	„
Apical angle of the ventral valve	108°	

Locality and geological position.—The only specimen of this species that exists in the Salt-range collection was collected by myself in the section near Khura, in the top-beds of the middle division of the Productus-limestone.

Remarks.—The specimen that has served for description cannot be determined, I think, otherwise than as *Strophalosia excavata*. It is a specimen which holds about the middle place between the typical form and the Var. *lewisiana*, Kon. The triangular outline agrees with the typical form, but the small area and the character of the spination is rather more similar to *St. lewisiana*. On the whole, I think, I cannot be very wrong if I quote the specimen under the name of *Strophalosia excavata*, Gein.

2. STROPHALOSIA HORRESCENS, Vern., Pl. LXXV., fig. 6.

1842. *Productus calvus* (Sow.), Kutorga: Verhandl. der Kais. Russ. Min. Ges. zu St. Petersburg, p. 17, Pl. V, fig 1.
1842. *Productus horrescens*, Murch. Vern. Kayserl.: On the Geol. Struct. of Russ. and the Ural, p. 15.
1844. *Productus arcatus*, Kutorga: Verhandl. Kais. Russ. Min. Ges. St. Petersburg, p. 97., Pl. X, fig. 5.
1845. *Productus horrescens*, Vern.: Russia and the Ural Mountains, Vol. II, p. 280, Pl. XVIII, fig. 1.
1846. *Strophalosia horrescens* (Vern.), King: Ann. & Mag. Nat. Hist. Vol. XVIII, p. 28.
1847. *Productus horrescens* (Vern.), Koninck: Monogr. des genres Prod. et Chon., p. 153, Pl. XV, fig. 6.
1861. *Strophalosia horrescens* (Vern.), Geinitz: Dyas, Vol. I., p. 91, Pl. XVII, fig. 30.
1868. *Strophalosia horrescens* (Vern.), var. *pyramidalis* et var. *prismatica*, Golovkinsky: The Permian Formation in the centre of the Kama-Wolgaic Basin: Materials towards the Geology of Russia, Vol. I, p. 361, Pl. II, figs. 13—17.

Though three specimens of this species are known to me, yet none of them attains the size of those that have been figured by Mons. de Verneuil; otherwise, they are absolutely identical.

The general outline is more or less squarish, though the length of the hinge-line is very variable. The lateral margins of the shell always unite with the hinge-line at a sharp angle. The median part of the ventral valve is depressed, forming a broad but very shallow sinus, and the apex is truncated by the place of attachment of the valve to foreign bodies. The whole valve is covered with irregularly arranged spines.

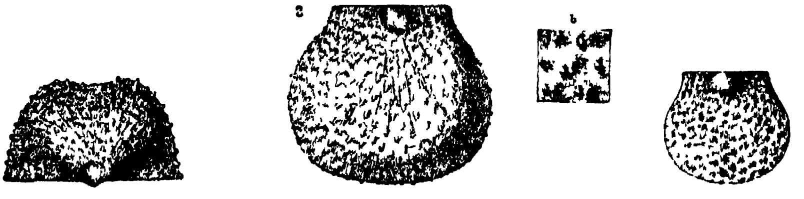

Fig. 18. STROPHALOSIA HORRISCENS, Vern. Three specimens from the lowest beds of the middle-P of Swás: 1. Apical view of the ventral valve, to show the place of attachment; 2. Dorsal valve, impression in the rock; 3. dorsal valve, outer side, (a) natural size, (b) portion of the shell enlarged.

The ventral valve is rather strongly inflated, and its curve is about equally strong in both directions. In the longitudinal direction the valve is most strongly elevated not far from the front, sloping thence slowly towards the apex and rather rapidly towards the frontal margin. Transversely, the valve appears highly elevated and flattened or slightly excavated in the middle, and the lateral parts descend most rapidly to the lateral margins. The apex is bent over and truncated in an irregular manner. The area is covered up by rocky matter and cannot be cleaned on account of the extreme hardness of the rock, but to all appearance it cannot have been very broad. The hinge-line is, in the specimens at my disposal, always shorter than the greatest breadth of the shell. The median sinus does not commence immediately at the apex but only at a certain distance from it: it is very shallow, and appears as a flattening rather than as an excavation of the shell; it occupies in its breadth the whole median part of the valve, and is limited on both sides by a kind of prominent, nearly angular folds. The lateral parts of the shell descend very steeply to the lateral margins, only in the vicinity of the hinge-line they are a little flattened forming a kind of small wings. The whole valve is covered by very irregularly arranged little spines, between which yet thinner spines can be observed very long and firmly pressed down towards the valve, by which circumstance they have been preserved. These thinner spines between the larger ones have, as far as I am aware, not yet been observed in Russian specimens of this species, but it seems to me that their occurrence entirely depends upon the mode of preservation. The Indian specimens are contained in an extremely hard limestone, and have apparently undergone a very strong pressure, by which these slender spines, which originally rested for their whole extent on the shell surface, have been pressed into the shell substance and have thus been preserved. In another kind of rock every trace of these spines would have been destroyed. Thus I think these are not of very great importance for the determination of the species. Fine concentric striæ of growth are present, but they are not very conspicuous.

The dorsal valve is entirely flat in the visceral portion, whilst the margins suddenly bend up so as to let the whole valve appear more or less concave. The hinge-line is straight, of variable length, and forms always angular wings with the lateral margins of the valve. The area is quite linear. The apex is pointed and slightly prominent, owing to the apical region being a little vaulted corresponding to the truncation of the beak of the other valve. The whole valve is covered with little shallow grooves, corresponding to the spines of the ventral valve. Between these grooves little prominent spines are irregularly disseminated. Some of these spines are also pressed into the shell substance as on the other valve.

The substance of both valves is very thin, and the inner side is just the reverse of the outer one. Though the inside of both valves is well observable on the specimens at my disposal, yet the muscular impressions, as well as the brachial ridges, are so faintly developed that it is impossible to distinguish anything.

The measurements of a ventral valve from Swás are as follow :—

Entire length of the shell	25	mm.
„ breadth of the shell	23	„
Length of the hinge-line	18	„
Entire thickness of the shell	14	„
Apical angle of the ventral valve	93°	

An isolated dorsal valve from the same locality is of somewhat larger dimensions, and indicates a considerably larger individual.

Locality and geological position.—There are altogether three specimens of this species known to me, which all three come from one and the same piece of rock. The specimens consist of two dorsal and one ventral valve, obtained from the same slab of rusty-coloured hard limestone which furnished also many specimens of *Chonetes strophomenoides*, W., and *Chon. compressa*, W.* It has been stated above that this piece of rock came from Swás out of the lower region of the middle Productus-limestone.

Remarks.—The form, which I have described here under the name of *Stroph. horrescens*, seemed to me not distinguishable from the typical form described by Mons. de Verneuil from the permian beds of Russia; and the similarity of the Indian specimens to the Russian seems to me so great, that the entire description as given by Verneuil, word for word, might be applied to them. The most striking character, which is scarcely ever absent in the true *Strophalosiæ*, is the place of attachment on the apex of the ventral valve. Among all the *Strophalosiæ*, occurring in European permian beds, as well as in those that have been found in the Salt-range, this point of attachment is never entirely absent, though it is sometimes rather small, as for instance in *Stroph. excavata*, etc.; and it is this point of attachment which enables us to distinguish between *Strophalosia* and *Productus* in cases in which the existence of cardinal teeth in the ventral valve is not known. The presence of a small area in the ventral valve is utterly unfit for such a distinction, as it is well known that most species of *Productus* might produce a small area in the ventral valve under certain circumstances. This, it seems to me, must be taken into consideration in judging of the figures given by Abich in his "Geologische Forschungen in den Kaukasischen Ländern," Vol. I, Pl. V, figs. 2 and 3, to which have been applied the names of *Productus humboldti*, Orb., and *Prod. scabriculus*, Mart., respectively by the author, but which have been considered to represent *Stroph. horrescens*, by Val. von Möller, on account of the occurrence on one of these specimens of an area in the breadth of one millimeter. Among the specimens of the *Productus humboldti* group, which occur in great numbers in the Salt-range, there are many in which such a small area occurs, and which I am absolutely unable to distinguish from the true *Productus humboldti*, Orb., on the one hand and from Abich's figures on the other. The point of attachment as well as the vertical sides by which the shell appears as if laterally compressed (on both which points great stress is laid in Verneuil's characteristic of the *Strophalosia horrescens*) are absolutely absent in Abich's figures, and thus Mr. Abich's determinations seem to be not quite so abortive as they have been represented to be by Mr. Möller. Thus I have also not accepted Abich's figures as representing *Stroph. horrescens*, and have not quoted them in the table of synonyms preceding the species.

c.—GROUP OF *STROPHALOSIA CORNELLIANA*, Derby.

3. STORPHALOSIA RARISPINA, Waagen, n. sp., Pl. LXV, figs. 6, 7, 8, 9.

1862. *Strophalosia morrisiana* (King), (?) var. Davidson: Quart. Journ. Geol. Soc. London, Vol. XVIII, p. 32, Pl. II, fig. 8.

1863. *Strophalosia morrisiana* (King), (?) var. (Davidson), Koninck: Foss. paléoz. de l'Inde, pag. 39, Pl XII, fig. 8.

Mr. Davidson, in his cautious and conscientious manner of recording the results of his observations, quoted the present species under the heading of *Stroph. morris-*

iana, King, (?) var., in order to express on the one hand his conviction that the present shell was identical with King's species, but yet to show on the other hand that there existed some slight discrepancies, which might, if more extensive materials were procurable, make his determination somewhat doubtful. Mr. Davidson had only two specimens, from the upper region of the middle Productus-limestone of Musakheyl, at his disposal; but in the Salt-range collection more than a dozen specimens of this species are preserved, and all show, with the greatest constancy, the same discrepancies from *Stroph. morrisiana* which were pointed out by Mr. Davidson; and thus, it seems to me, the Indian specimens cannot be retained in King's species.

The general outline of this species is very variable and very irregular, but it is always somewhat longer than it is wide. The ventral valve is strongly inflated, with a more or less large point of attachment on the beak; the dorsal valve is concave; the former has not very numerous strong spines, the latter has only traces of them.

The ventral valve is strongly vaulted in both directions, but perhaps somewhat more strongly transversely than longitudinally. The curve is, however, not quite equal for its whole extent: in the longitudinal direction it is tolerably so, but transversely considered the shell appears distinctly depressed in the middle, and sometimes even a shallow sinus is developed. An apex is for the most part non-existant, but its place is occupied by the more or less large place of attachment of the valve. Below this the area extends; it is small, depressed triangular, provided in the middle with a small pseudodeltidium. The hinge-line is short, very considerably shorter than the greatest breadth of the shell. The whole valve is covered by not very numerous spines, which are on an average about 3 millimeters distant from each other. They are of two different kinds: one set is directed forward and more or less firmly pressed down to the surface of the valve; the other is erect, and projects perpendicularly from the surface of the valve. These two sets are quite irregularly mixed together, and show no regularity whatever in their arrangement. Between the spines the shell is smooth, showing only very faint slightly undulating striæ of growth. In some specimens a small number of these striæ of growth is more strongly marked and imbricating.

The dorsal valve is strongly concave, but its external side is rather imperfectly known to me, as no specimen is in my possession showing this valve in a well-preserved state. In the vicinity of the apex, which is slightly prominent, a smooth slightly convex space corresponds to the place of attachment of the other valve. The hinge-line is straight, the area very narrow and interrupted in the middle by the base of the cardinal process. The surface of the whole valve seems to be covered with little grooves, between which very small spines are disseminated.

Of the interior characters of this species only those of the dorsal valve are known to me. The cardinal process is strongly prominent, thick and tripartite at its upper extremity. It is prolonged towards the interior of the valve as a low median septum. At the base of the process, where it unites with the hinge-line on both sides of it, the very distinct and deep dental grooves are situated. The inner walls of the socket are made up of low, rounded diverging ridges, which originate at the base of the cardinal process. The muscular impressions are peculiar, and I am not quite certain as to how to interpret them. It seems to me that the inner pair of adductors must be considered as bifid, one division being situated above the other. These scars are strongly raised and thickened. The outer pair of adductors, on the contrary, seem to be situated in deep grooves outside and somewhat above the preceding. The brachial ridge is very faint and barely perceptible. It makes a large and widely open curve and joins in the middle the end of the median septum. The whole interior surface of this valve, with the exception of the muscular impressions, is covered by a very fine and very close granulation, which is indistinctly arranged in radial rows.

The measurements of two specimens from near Uchāli are as follow :—

	I.	II
Entire length of the shell	22 mm.	19 mm
Length of the dorsal valve	19 „	?
Entire breadth of the shell . . .	20.5 „	18 „
Length of the hinge line	10 „	9.5 „
Entire thickness of the shell	12 „	10 „

and geological position—The chief distribution of this species is in the middle division of the Productus-limestone, but in some rare specimens it occurs also in the upper division, up to the Cephalopoda-bed where it is replaced by the next following one. In the middle region of the middle division I collected the species myself on the road between Vurcha and Uchāli (4 specimens) and at Káfirkot (6 spec.). Mr. Wynne found it in the same geological position at Swás (1 spec.). In the upper region of the middle division the species has been observed by Mr. Wynne at Chidru (1 spec.); also Mr. Davidson's specimens came probably from the same horizon at Musakheyl. At the very base of the upper division, I collected one specimen west of Khura; and at last, in the middle region of the upper division, I found the species (2 specimens) at Chidru.

Remarks.—This species has been described by Davidson under the name *Strophalosia morrisiana*, King, var., and I must state my reasons for not concurring in this view with Mr. Davidson. Already that author himself drew attention to the fact that the longitudinal striation present in all the well-preserved specimens of *Stroph. morrisiana*, is absent in the Indian shell. It is true that also in *Stroph. morrisiana*, if the surface is not well preserved, the striation is apparently absent; but as little it can be denied, that for the majority of specimens the striation is characteristic. Now, as Mr. Davidson had only two Indian specimens for description, it is not improbable that these two specimens were just not quite well preserved, and so no great stress could be laid on the absence of the striation. But as among my material I have specimens in the very best preservation imaginable, in which also every trace of a striation is absent, this smoothness of the shell must be considered as constituting a specific peculiarity. But also in the spines a difference exists. In *Stroph. morrisiana* the spines are nearly all directed forward and pressed down, and erect spines occur only in the region of the apex and on the sides. In the Indian specimens, on the contrary, erect spines are mixed all over the shell between the adpressed ones.

In this latter character, as well as in the smoothness of the shell's surface, the Indian shells resemble very closely another species, which has been described by Derby from upper-carboniferous beds of Brazil under the name of *Stroph. cornelliana.* Already Mr. Derby pointed out the close affinity of his species to the Indian form, but I cannot recognise a specific identity, such as Mr. Derby suspected. *Stroph. cornelliana* is more circular in its outline, smaller, and bears by far more numerous spines, the distance between the single spines being in the South American species only one millimeter, whilst this is three millimeters in the Indian shells.

That *Stroph. cornelliana*, as well as our *Stroph. rarispina*, is nearly related to *Stroph. goldfussi*, Münst., has also been already pointed out by Mr. Derby. A specific identity exists, however, in no case. The differences between *Stroph. cornelliana* and *Stroph. goldfussi* have been indicated already by Mr. Derby; between our *Stroph. rarispina* and Count Münster's species these differences consist in the by far more numerous spines, which are all erect in the ventral, and the by far stronger and more numerous spines in the dorsal valve in *Stroph. goldfussi*. *Stroph. cornelliana* is a truly carboniferons species, and it is highly probable that it is the ancestor on the one hand of *Stroph. rarispina*, W., and its allies, and on the other of *Stroph. goldfussi*, Münst., and the other European species. The radially striated *Stroph. morrisiana*, King, belongs to another series of forms.

4. Strophalosia indica, Waagen, n. sp., Pl. LXV., figs. 1—4.

This species is very nearly related to the preceding one, but it is generally broader in its outline and bears a greater number of spines.

The ventral valve is strongly inflated, and its curve is very regular in both directions, a median longitudinal impression never occurring: (the front view, fig. 1 *d*., Pl. LXV, in which the shell appears somewhat depressed in the middle, is not quite correct). The apex is quite obliterated by the large place of attachment by which it is truncated. Below, there is a tolerably large, smooth, triangular area, which is interrupted in the middle by an extremely narrow and slightly prominent pseudodeltidium. The hinge-line is very considerably shorter than the greatest breadth of the shell. The valve is rather thickly covered with two sets of spines, of which one is directed forward and firmly pressed down to the surface of the shell, whilst the other is erect already from its beginning. The spines are about one and a half to two millimeters distant from each other. In large specimens the margin of the valve becomes coarsely and radially plicated. The depressed spines are situated, for their whole extent, so strictly in the plane of the shell's surface that, in its advancing growth, the shell very often embodies them in its substance, and thus they are on their lower part covered up by shelly matter.

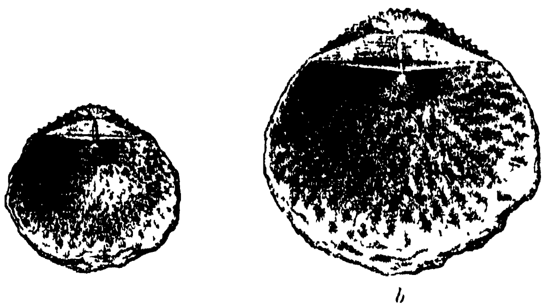

Fig. 19 Strophalosia indica, W., n. sp. Dorsal valve of the specimen figured Pl. LXV, fig. 1, entirely cleaned *a*. natural size; *b*. enlarged.

The dorsal valve is concave. The apex is slightly prominent and encircled by a smooth space, corresponding to the place of attachment of the other valve. The valve bears a narrow but very distinct area, which is interrupted in the middle by the very narrow base of the cardinal process. The whole valve is covered by a very characteristic minute grooving, between which extremely fine erect spines are irregularly distributed.

The surface of the shell in both valves is perfectly smooth between the spines, and only very faint striæ of growth can be observed, but no radial striation.

Of the interior characters of this species only those of the dorsal valve are known to me. The cardinal process is small and little prominent. It is continued below in a low median septum and is joined laterally at its base by two projecting ridges which form the inner walls of dental sockets. The muscular impressions are very distinct. The inner pair of adductor scars is raised, and each scar is divided by a curved transverse projecting ridge. The whole scar forms a roundish mass. The outer pair of adductors is apparently inserted in deep grooves that encircle the scars of the inner pair above and somewhat outside; each scar is of about semi-lunar shape. The brachial ridges are, in all specimens at my disposal, so faint that they cannot be at all distinguished. Instead of them a smooth shield-like space is observable extending below the scars on both sides of the faint median septum. The meaning of these features I do not know. The whole interior side of the valve is covered by a very finely-granulated radial striation.

In the ventral valve, very strong cardinal teeth are situated on both sides of the deltidial fissure.

The measurements of a full-grown specimen from Jabi are as follow:—

Entire length of the shell	23	mm.
Length of the dorsal valve	20	„
Entire breadth of the shell	24	„
Length of the hinge-line	14	„
Entire thickness of the shell	12	„
Distance of the two valves from each other	7	„

Locality and geological position.—This species is entirely restricted to the Cephalopoda-bed of the upper Productus-limestone, but is extremely common in

Locality and geological position.—The present species is entirely restricted to the lowest fossiliferous beds above the lavender-clays, and occurs most numerously in this geological position in the Chittawán near Ghari, where in a hard dark-gray calcareous sandstone, weathering of a rusty colour, thousands of specimens are imbedded; they can however only with difficulty be extracted from the hard rock. At other localities the species is much rarer. It has been collected by myself in absolutely the same geological position, near Amb, in a dark coaly sandstone (2 specimens); and by Mr. Wynne near Dokri (5 spec.) and near Khairabad (1 spec.).

Remarks.—The species here under consideration seems to be very nearly related to *Stroph. gerardi*, King, from beds of unknown age of the Himalaya. I should have liked to identify the present shell with the Himalayan one, but after a lengthened consideration I do not feel justified in doing so. The shell from the Salt-range is always narrower and more semi-globose, the apex much more strongly bent over, the area of the ventral valve smaller, and that of the dorsal one nearly quite absent. Then, the thick radial folds that appear with the progressing size of the specimens, and the but little marked spines on the surface of the ventral valve, all characters by which the Salt-range shell differs from the Himalayan one, forbade the identification: thus I was forced to give a new name to the shell here under consideration.

Of other species none can be compared, more particularly with the present one.

6. STROPHALOSIA NODOSA, Waagen, n. sp., Pl. LXIV, figs. 8, 9.

The general outline of this species is not much different from that of the preceding one, but it never attains the same size and generally bears a larger point of attachment in the ventral valve. The chief difference, and at the same time the most striking character of the present species, consists in the sculpture, which is composed of spines of very different size, very thin ones and very thick ones, which are all very irregularly disseminated over the surface of the ventral valve.

The ventral valve is very strongly inflated, nearly semi-globose, with a tolerably equal curve in both directions. The hinge-line is very short, but nevertheless projecting slightly at both ends, so that the ends can be seen in a ventral view of the shell as little projecting corners. The area is tolerably large, concave and interrupted in the middle by a very narrow little-vaulted pseudodeltidium. The apex is prominent, sometimes indistinctly pointed, sometimes truncated, and not much bent over. The most characteristic feature of the valve is its sculpture. It consists altogether of erect spines, which are, however, of very different sizes. One set of them is extremely thin, and leaves barely perceptible points on the surface of the valve when the spines are broken off; the other set is very thick and in case of fracture leaves thick knob-like projections on the valve. The relative number of the two sets is very variable, and sometimes the thin, or again the thick set is the more prevalent. If the former is the case, the thick spines are sometimes only represented by the number of five or six on the whole surface of the valve. Also, the distribution of the two sets is very irregular, and both kinds are disseminated quite irregularly between each other.

The dorsal valve is not quite well preserved in any of the specimens at my disposal. It is concave, with a slightly prominent apex, round which the valve is a little vaulted according to the point of attachment of the other valve. The area is very distinct and comparatively broad, interrupted in the middle by the small knob-like root of the cardinal process. The whole valve seems to be covered with irregularly distributed little pits, but it cannot be stated whether little spines were disseminated between them or not.

The interior characters of the species are also very imperfectly known to me. It is certain that the ventral valve possessed very narrow but very long and well-developed cardinal teeth, which fitted into very deep dental grooves in the dorsal valve. The muscular impressions are apparently in both valves much in the same way as in other species of *Strophalosia*, but they are rather indistinct in the specimens at my disposal, and the brachial ridge cannot be at all distinguished.

The measurements of two specimens from Amb are as follow :—

	I.	II.
Entire length of the shell	25 mm.	19 mm.
Length of the dorsal valve	21 ,,	17 ,,
Entire breadth of the shell	27 ,,	19 ,,
Length of the hinge-line	19 ,,	11 ,,
Entire thickness of the shell	13 ,,	11 ,,
Distance of the valves from each other	8 ,,	?
Apical angle of the ventral valve	117°	118°

The specimen No. I is the largest known to me of this species.

Locality and geological position.—The present species was detected by me only at a single locality in the Salt-range. This was at Amb, where it occurs rather plentifully in the *Chonetes*-bed of the lower Productus-limestone. I brought away 27 specimens.

Remarks.—In its general outline the present species is very nearly related to the preceding *Strophalosia plicosa*, but the hinge-line is a little longer and slightly projecting at both ends, and the sculpture is quite different. The knob-like insertions of the thick spines, which are erect from their roots, are very different from the insertions of the spines in *Strophalosia plicosa* which are thin and directed forward, though afterwards these spines also become erect. It needs only a look at the figures to make these differences apparent.

There exists, moreover, a similarity to another species, and this is the true *Strophalosia goldfussi*, Münst., as described by Geinitz. In general habitus both species seem to be very similar, chiefly by the circumstance that in both the spines are erect from their roots, but in *Strophalosia goldfussi* the spines are much more numerous than in the Indian shell, and the dorsal valve bears also strong spines, which is decidedly not the case in *Strophalosia nodosa*.

7. STROPHALOSIA TENUISPINA, Waagen, n. sp., Pl. LXIV, figs. 2—7.

The general outline of this species is circular to transversely oval. The ventral valve is not much inflated and is covered by very fine spines, which are directed forward. The interior of the dorsal valve is very peculiar.

The ventral valve is nearly flat to slightly inflated, and its curve is tolerably regular in both directions; only longitudinally the curve is perhaps somewhat flatter in the apical than in the frontal region. The point of attachment on the apex of this valve is very small; and the truncation of the apex, which is caused by it, is only preceptible on a very close examination. The apex is slightly bent over but not prominent, and thus the area appears quite flat, not concave. This latter is not very large and bears in the middle a narrow pseudodeltidium. The hinge-line is comparatively long and projecting at both ends. The surface sculpture of the valve is characteristic for the species. I have figured different states of preservation on Pl. LXIV. In the specimen represented in fig. 3, the spines are entirely broken off on the greater portion of the shell, so that nothing but the roots remain. In figs. 2, 6, and 7, on the contrary, small pieces of the spines still adhere to the roots, and thus the whole aspect of the shell is changed. The spines are thin, directed forward, firmly pressed down to the surface of the valve and arranged approximately in concentric rows, which are marked by well-developed imbricating striæ of growth. There are no erect spines disseminated between the adpressed ones.

In the dorsal valve, I have not succeeded in cleaning the outer side from the adhering rock matter; it seems, however, that this valve was provided with spines very similar to those of the other valve. The area of this valve is small, nearly linear.

Of the interior characters of this species, only those of the dorsal valve are known to me. The cardinal process is rather small, and bears at its base on both sides the very deep slit-like dental grooves, which approach each other very nearly, leaving only a thin shelly mass between them. The cardinal process is prolonged into a distinct median septum, which extends for about half the length of the dorsal valve. The two pairs of adductor impressions are very clearly distinguishable. The scars are somewhat lozenge-shaped, the inner pair larger and slightly raised, the outer pair shorter and excavated. The brachial ridges are not distinguishable. In their place a shelly callosity of a somewhat bilobed outline exists. The whole internal surface of the valve, with the sole exception of the muscular impressions, is covered with a finely granulated radial striation.

The measurements of two full-grown specimens from Amb are as follow :—

	I.	II.
Entire length of the shell	23 mm.	23 mm.
„ breadth of the shell	26 „	27 „
Length of the hinge-line	? 14 „	15 „
Entire thickness of the shell	10 „	7 „
Apical angle of the ventral valve	123°	141°

Locality and geological position.—Like the preceding species this one also is restricted to a single bed and locality in the Salt-range. I collected the species at Amb in the so-called *Chonetes*-bed, associated with *Chonetes ambiensis*, W., *Strophalosia nodosa*, W., and several other species. The present species is, however, considerably rarer than those two forms; I brought away only ten specimens.

Remarks.—The present species seems to be more or less nearly related to several of the forms previously described, and chiefly there exists a rather close similarity between the present shell and *Stroph. plicosa*. Nevertheless, I think the two shells can well be distinguished, as *Stroph. tenuispina* has a much less strongly inflated ventral valve and finer and much less numerous spines. The dorsal valve, so far as it can be observed, is entirely different, as it possesses apparently comparatively strong spines, while that of *Stroph. plicosa* shows only fine lamellar striæ of growth.

A closer comparison of the present species with the forms of the group of *Stroph. goldfussi* or of the group of *Stroph. cornelliana* seems hardly necessary, as the shell here under consideration seems to be sufficiently distinct to allow of its being recognised without indication of the distinguishing characters.

d.—GROUP OF *STROPHALOSIA LEPLAYI*, Geinitz.

8. STROPHALOSIA COSTATA, Waagen, n. sp., Pl. LXIII, figs. 7, 8; Pl. LXIV, fig. 1.

This neat little species is of a transversely oval or somwhat rectangular outline, with a strongly inflated ventral valve and a sharply costate surface. On the costæ moderately projecting spines are distributed.

The ventral valve is strongly vaulted, with a distinct longitudinal sinus in the middle. Its curve is rather regular and equal in both directions. The apex is mostly truncated by the place of attachment of the valve; but in some cases, when the shell has been fixed during its youth to a concave body, the apex is complete, though somewhat crumpled, and then it is pointed and strongly bent over. The hinge-line is always shorter than the greatest breadth of the shell. The area is concave and narrow, and the deltidial fissure seems to be small, but it cannot be distinctly seen in any of the specimens, as just this part is always covered up by very hard rock matter. The whole surface of the valve is covered by very strong radiating ribs, which sometimes bifurcate and are ornamented at intervals with strong spines. In specimens with a small point of attachment, and which in consequence have a longer hinge line, a greater number of spines is clustered together towards both ends of this line. In other specimens, with a large point of attachment and a shorter hinge-line, these spines are very much reduced in size and number, or they are even entirely absent. But otherwise, in all specimens the radiating ribs are strongly nodose and ornamented with spines, which are distributed quite irregularly over the whole valve.

The dorsal valve is flatly concave, with a but slightly developed median fold. The apex is pointed and slightly prominent, surrounded by a convex part of the shell corresponding to the place of attachment of the other valve. A narrow but distinct area is present in this valve. The surface of the valve, with the exception of the convex part round the apex, is covered with low radiating folds, between which shallow pits correspond to the places where on the other valve spines are situated. These pits sometimes become the leading feature of the valve as in the specimen of which an enlarged figure is given, Pl. LXIV, fig. 1c. This valve is absolutely devoid of any trace of spines. Faint concentric striæ of growth can be observed.

The internal characters of this species are entirely unknown to me.

The measurements of two specimens, No. I from the *Chonetes*-bed, and No. II from the lowest fossiliferous bed above the lavender-clay of Amb, are as follow:—

	I.	II.
Entire length of the shell	14 mm.	13 mm.
Length of the dorsal valve	12 „	11 „
Entire breadth of the shell	20 „	14·5 „
Length of the hinge-line	16 „	10 „
Entire thickness of the shell	10 „	7 „
Distance of the two valves from each other	? „	5 „
Apical angle of the ventral valve	85°	?

Locality and geological position.—There are altogether only three specimens of this species known to me, all three of which were collected by myself; one of them in the *Chonetes*-bed and the two others in the lowest fossiliferous beds above the lavender-clay; that is to say, all three in the lower division of the Productus-limestone, at Amb.

Remarks.—The present species seems to all appearances very nearly related to *Stroph. leplayi*, Gein., of the European permian formation. Some confusion seems, however, to prevail about this European species, and it is necessary to state first what I include under the name. From permian beds of Russia a shell had been described by Count de Verneuil under the name of ***Productus leplayi***, which afterwards was identified by Geinitz with a shell from the "Weissliegenden" of Ticochitz near Gera, and which was manifestly a *Strophalosia;* so that Geinitz in his text of the "Dyas" changed the name of ***Productus leplayi*** into ***Strophalosia leplayi***. But afterwards he himself seems to have become uncertain of the identification, and on the explanation of the plates he quotes two species one at the side of the other: ***Productus leplayi***, Vern., and ***Strophalosia leplayi***, Gein. This latter proceeding seems to me the correct one. *Strophalosia leplayi* differs, according to my opinion, from ***Productus leplayi*** by its much smaller size, the fine radial striation, the shorter hinge-line, and the attached ventral valve. That the ventral valve of ***Strophalosia leplayi*** was in reality attached appears beyond all doubt from Geinitz's figures and description of the species: in these he mentions and draws a smooth space round the apex of the dorsal valve, a character which would not be present if the ventral valve was quite free as this smooth space of the dorsal valve just corresponds to the place of attachment of the ventral one. It needs only a look at Geinitz's figures (chiefly fig. 25, Pl. XIX of the Dyas) to become convinced of the circumstances. It is this *Strophalosia leplayi* to which I think that the Indian *Strophalosia costata* is most nearly related. Some palæontologists might perhaps be inclined to consider the two as identical, but I think one should not go so far in the identification. *Strophalosia costata* is slightly larger, has got coarser radial ribs, and bears more spines on them; and thus I should rather advocate its specific separation from the European permian shell. Nevertheless, the very near relation of the two forms remains, and it is probable that the *Strophalosia costata* must be considered as a geographical variation or representative form of *Strophalosia leplayi*.

Of other species there is none known to me, to which the shell here under consideration could be more particularly compared.

Genus: CHONETELLA, Waagen, n. gen.

There is only a single species for which I have to introduce this new genus, but it is very common in the Salt-range, and its external and internal characters are so peculiar, that I cannot place it in any of the genera which have been distinguished up to the present.

On the first glance everybody would take this shell to be a *Productus*, as its external appearance is entirely *Productus*-like. But on a closer examination one finds that the ventral valve bears a narrow but distinct area, which is interrupted in the middle by a small deltidial fissure; and it is ornamented along its upper margins on both sides of the apex with thin spines, just as they occur in the genus *Chonetes*. Also in most specimens a linear area exists in the dorsal valve. The chief distinguishing characters of the genus are however to be found in its internal peculiarities.

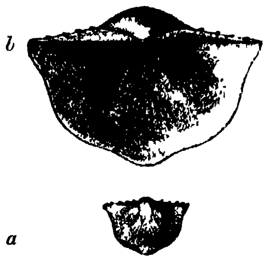

Fig. 20. CHONETELLA NASUTA, W., n. gen. et sp. Specimen from the Cephalopoda-bed of Amb: *a*. internal cast of the ventral valve, natural size, *b*. gutta-percha impression of the same, enlarged.

The ventral valve bears on both sides of the deltidial fissure rudimentary cardinal teeth. The muscular impressions are deep and large. The adductors have left somewhat reniform elongated impressions on both sides of the middle line, not far from the apex; they are however not dendritic; the divaricator impressions are larger and situated somewhat outside and lower down than the preceding. They are of a somewhat rectangular shape and longitudinally striated as in *Productus*.

In the dorsal valve a very small trilobed cardinal process exists, at the base of which on both sides are situated very indistinct shallow dental grooves. The cardinal process is continued as a thin, low median septum down to about half way in the length of the valve. The muscular impressions are very distinct. All four are somewhat lozenge-shaped, and the inner pair is somewhat larger than the outer one, and at the same time somewhat lower down in its position. None of the impressions is dendritic. The brachial ridges are very distinctly visible in all the specimens at my disposal, but their origin remains always doubtful. It would appear as if they originated at the lower end of the outer pair of adductor impressions, but I cannot be quite certain of the circumstance. So much is however certain, that they do not distinctly proceed from between the two pairs of adductor impressions as is the case in other *Productidæ*. The form of these sharply prominent ridges is at the same time very peculiar; they first descend in a broad curve, about parallel to the margin of the valve, and then suddenly bend round in a narrow curve as if they would form a spiral, and terminate suddenly as if cut off. I have figured these specimens in order to show that these characters are constant. The whole interior surface of the valve is largely papillate, except the space within the brachial ridges.

From this description of the characters, it appears that the shells here under consideration are truly transitional forms between *Chonetes* and *Productus*. They can, however, not be united with *Chonetes* on account of the scarcely developed area and hinge teeth, nor with *Productus* on account of the little spines with which the upper margins of the area are ornamented. Charact in which the present genus deviated from all the other genera of the *Productidæ* are exhibited in the brachial ridges of the dorsal valve.

If we take exception to the two above-mentioned genera, the form here under consideration can only as yet be compared to those shells which have received the names of *Prod. llangollensis*, Dav., and *Prod. comoides*, Sow., and which constitute to my view the genus *Daviesiella*, Waagen. From these shells, the present form is distinguished by the absence of a second pair of adductor impressions in the ventral valve and by differently disposed brachial ridges.

The genus is represented in the Salt-range by a single species, which will receive the name of *Chon. nasuta*, W. I know of no other shell in any country which with any probability could be attributed to the present genus.

I.—CHONETELLA NASUTA, Waagen, n. gen. et sp, Pl. LXXXI, figs. 3—8.

For a long time I considered this little shell as a *Productus*, and only after a very close and very careful investigation was I convinced that I had in it to deal with a shell of different generic characters.

The general outline of the shell is entirely like that of a *Productus*. The ventral valve is very strongly inflated in the middle with little wings on both sides. It bears a fine radial plication, and in the middle of the frontal margin a large nose-shaped process. The dorsal valve is strongly concave. The distinct area which exists in both valves is almost entirely concealed, as it is so strongly overhanging that its upper sharp margins appear as if they were the hinge margin.

The ventral valve is very strongly inflated, its curve being very regular in the longitudinal as well as in the transverse direction, the lateral wings being but little flattened and slightly projecting. The apex is slightly prominent, pointed and very strongly bent over. The area is tolerably broad, a little concave and quite concealed below the apex. It is cut open in the middle by a rather narrow deltidial fissure. The upper very sharp margins of the area are ornamented with four to five spines on each side of the apex, which are directed towards the end of the hinge-line. Not far from the apex, a generally very shallow sinus commences and about half way to the front suddenly changes into a high and prominent fold, which is prolonged in the front into a narrow, long, nose-shaped process. The whole valve is covered with a rather faint radial plication, which is sometimes well developed, sometimes barely at all preceptible. The single folds are narrow, rounded on the top, and often dichotomous towards the frontal margin. As a very great exception (in two cases among the 30 specimens at my disposal), one or the other of these ribs bears a spine somewhere in its curve. The number of the radial folds is between twenty and thirty.

The dorsal valve is concave, and is in every respect the reverse of the other valve. It bears a prominent median fold to about half way from the apex, when this suddenly changes into a deep rather narrow furrow, which is prolonged into the nose-shaped process. The lateral portions of the valve bear a more or less distinct radial plication. Along the hinge-line, a narrow but distinct area extends, which is interrupted in the middle by the little prominent cardinal process.

The interior characters of the species are such as have been described in the characteristic of the genus.

The substance of the shell is of a silky lustre as in *Productus*, but I cannot detect in any of the specimens, when the outermost shell layer is destroyed, the fine punctures, which are so very characteristic for the shell of *Productus*.

The measurements of two specimens, No. I, a strongly inflated variety with small wings, from the base of the upper Productus-limestone of Khura, and No. II, a less strongly inflated variety with large wings, from the Cephalopada-bed of Chidru, are as follow :—

	I.	II.
Entire length of the shell	13 mm.	9 mm.
Length of the dorsal valve . . . . :	9 „	7 „
Entire breadth of the shell (at the hinge-line)	13 „	14 „
„ thickness of the shell	7 „	5 „
Apical angle of the ventral valve	122°	130°

The distance of the two valves from each other is 3mm, in a specimen of 10mm. in length. The specimen No. 1 is the largest one known to me.

Locality and geological position.—This is a rather common species in the Salt-range, and it extends through the whole middle and upper divisions of the Productus-limestone. It is, however, most numerous in the lower beds of the upper division.

The geologically oldest specimen that is known up to the present was collected by myself at Katta in the lower beds of the middle Productus-limestone (bed No. 12 of my note-book) (1 spec.). In somewhat higher beds of the middle division, I found the species in the section near Khura (1 spec.), and in the middle region of the middle division, on the road between Vurcha and Ucháli (4 spec.), and at Káfirkot (4 spec.). The top beds of the middle division have furnished specimens at Khura (1 spec.) and at Kálabágh (1 spec).

In the lower region of the upper division the species was collected by myself west of Khura (18 spec.), and at Katwáhi (4 spec.). Lastly, in the Cephalopoda-bed of the upper Productus limestone, the species occurred at Jabi (9 spec.) and at Chidru (4 spec.).

Remarks.—As the present species has in its external appearance entirely the look of *Productus*, it is also among the species of that genus that we must look out for relations to the present form. In fact there is such a shell, and it has been described by Mr. Davidson as an exceptional shape of *Productus longispinus*, Sow. These little shells have been found in carboniferous-shale near Carluke in Lanarkshire, and as I have not got specimens for comparison I must rely entirely on Mr. Davidson's drawings, which are, however, of such a well-known quality that they appear as nearly of the same value as natural specimens. Above all, it appears highly probable that these little shells, though the interior of the dorsal valve is not known, belong to my genus *Chonetella* as in fig. 18 (Pl. XXXV of the Carboniferous Monograph). Mr. Davidson draws a distinct area in the ventral valve. As to specific differences, the shell from the mountain-limestone has apparently no spines along the upper margins of the area of the ventral valve, and on the surface of the ventral valve much more numerous spines seem to be present than in the Indian species, where the occurrence of a spine anywhere on the ventral valve, except along the margins of the area, is a very great exception.

Now these little shells, the Indian as well as the English, ought not, according to my opinion, to be considered as simple varieties of *Productus longispinus*, Sow., as their internal structure is very different. *Productus longispinus*, Sow., and its allies belongs to that group of forms which I shall consider later on in the text under the name of *Marginifera*, and the characters of which group will be duly described in the right place. Of these characters, however, not a trace is to be found in *Chonetella*, and thus these shells appear not only specifically but even generically different from *Productus longispinus*.

Sub-family: *PRODUCTINÆ.*

Genus: AULOSTEGES, Helmersen.

The occurrence of this genus in the palæozoic strata of the Salt-range is of very great interest, so much the more as I am in a position to add to the species already made known by Mr. Davidson, a new one which is very common at certain localities.

The generic characters seem not yet quite definitely fixed, as every new species that becomes known adds something new to our knowledge of these characters, and thus it appears difficult to draw up a generic description.

The general shape of the shells belonging to the genus is flat, with a convex ventral and a flat or concave dorsal valve. The ventral valve, though mostly with a deformed apex, as *Streptorhynchus*, is never attached but always free. It is provided with a more or less large flat area, which bears in the middle a narrow pseudodeltidium, provided, if well preserved, with little spines. Interiorly this valve seems to be generally edentulous; but in the specimen of *Aul. dalhousii*, figured by Davidson, small rudimentary hinge-teeth are drawn and described, so that hinge-teeth seem to have been sometimes developed. In the other species occurring in the Salt-range no hinge-teeth are present. The muscular impressions of the ventral valve connot be observed in any of the Indian specimens.

The dorsal valve has a linear area, a large cardinal process, and dendritic adductor impressions. The brachial ridges reach far down to near the margin of the valve, but are otherwise like those of *Productus*. This seems to be the case in *Aulosteges wangenheimi*, Vern., and *Aulosteges dalhousi*, Dav. The arrangement of the brachial ridges is, however, quite different in *Aulosteges medlicottianus*, W., the second species that occurs in the Salt-range, and perhaps this arrangement could be made use of to distinguish this shell generically; but I should not like to advocate this, as only a single interior side of the dorsal valve of this species is known to me, and it would be desirable to make some further investigations before deciding on this question. The brachial ridges are very short in this species, proceed horizontally from between the muscular impressions, then bend round in a sharp corner, and return with a somewhat parabolical curve to the median septum.

The geological distribution of the genus is chiefly permian, and it has been already remarked by Davidson that the occurrence of a species of *Aulosteges* in the Salt-range might indicate the existence of permian strata there.

In the Salt-range the two species which exist there occur at two different horizons. The species that has been described by Davidson, *Aul. dalhousii*, belongs to the upper region of the middle Productus-limestone of Musakheyl, and the second species, *Aul. medlicottianus*, W., is restricted to the lower Productus-limestone, but it occurs there at different localities and sometimes in great numbers.

The two species are, however, apparently in no connection whatever together.

1. AULOSTEGES DALHOUSII, Davidson, Pl. LXIII., fig. 1.

1862. *Aulosteges dalhousii*, Davidson: Quart Journ. Geol. Soc., Lond., Vol. XVIII., p. 33, pl II., fig 7.
1863. *Aulosteges dalhousii*, (Dav.) Koninck: Foss. paléoz. de l'Inde, p. 41, pl., XII., fig. 7.

I regret to say that the materials of this species at my disposal are very scanty, only a single-well preserved ventral valve being contained in the Salt-range collection. I must thus, in everything that regards the dorsal valve, copy from Mr. Davidson's description.

The general outline of the shell is broadly triangular, with a vaulted ventral and a flat or slightly concave dorsal valve. The hinge-line is short, not projecting at both ends, and the area of the ventral valve very large and reclining.

The ventral valve is not very strongly vaulted, and its curve is very irregular. Longitudinally, the valve is tolerably flat to not very far from the front, then it suddenly bends up to the front line. Transversely, the curve is more regular, but indented in the middle by the broad and deep median sinus, which extends from the front line to about half way up the length of the shell. The apex is prominent, pointed and a little bent over in normal specimens, but very strongly incurved and somewhat swollen in my specimen, a conformation which is evidently caused by malformation. The area is very large and flat, very strongly striated vertically, and with a few inbricating striæ of growth parallel to the hinge line. It is interrupted in the middle by a very narrow deltidial fissure, which is of nearly equal breadth for its whole extent. This fissure is bridged over nearly down to the very hinge-margin by a little vaulted pseudodeltidium, which bears many imbricating striæ of growth and is thickly covered by little spines. At the hinge-margin it leaves only a very small space open for the reception of the apparently very small cardinal process of the dorsal valve. The whole surface of the valve, with the exception of the area, is covered with closely set spines, of which the majority is directed forward, whilst between them are some which are slightly thicker and erect. The spines with a forward direction are mostly pressed down firmly to the surface of the valve.

I do not know the dorsal valve of this species from my own observation. What Mr. Davidson says about this valve is as follows: The dorsal valve is convexo-concave,—that is to say, it is convex up to a little distance from the margin, and then bends up and becomes concave. The area of this valve is narrow and linear. The whole surface seems to have been covered with thin spines. Interiorly the cardinal process is trifid, and there are traces of the small dental sockets at both sides of its base. The cardinal process is continued in a small median septum which extends somewhat in excess of half of the length of the valve. On each side of this septum two elongated oval dendritic inpressions are to be found, which without doubt represent the impressions of the adductor muscles. At their inner extremities commence the reniform impressions (brachial ridges): these are marked by a curved line which, extending to near the margin of the valve and then abruptly bending round, terminates not far from the point whence it had started.

The measurements of the specimen at my disposal are as follow :—

Entire length of the shell	44 mm.
Height of area	10 „
Entire breadth of the shell	48 „
Length of the hinge-line	32 „
Breadth of the pseudodeltidium at the hinge-line	3 „
Entire thickness of the shell	19 „
Apical angle	100°

Locality and geological position.—There are altogether only two specimens of this species known up to the present. One of them was collected by Mr. Purdon, and has been described by Mr. Davidson, and the other was found by Mr. Theobald, and has served here for the description. Both these specimens come from Musakheyl, and were undoubtedly collected there in the upper beds of the middle Productus-limestone.

Remarks.—The present species appears on the whole to be very nearly related to *Aul. wangenheimi*. Vern., from permian beds of Russia. It is entirely of the same type and configuration, and it is highly probable that the two are either in a developmental connection, or that they are forms of the same geological age, representing each other in different geographical regions.

The difference that exists between the two forms consists chiefly in the smaller size of *Aul. wangenheimi* and in the finer and more erect spines that it bears on the ventral valve.

Aulosteges guadalupensis, Shum., is of the same type, and related as well to *Aul. wangenheimi* as to *Aul. dalhousii*; but this species is so badly figured that it is difficult to decide as to its specific identity or difference with any of the above species. It appears certainly to be much smaller than *Aul. dalhousii.*

2. AULOSTEGES MEDLICOTTIANUS, Waagen, n. sp., Pl. LXII.

The general outline of this species is more or less trapezoidal, with a moderately vaulted ventral valve which bears a shallow sinus in the middle. The area is comparatively small and the hinge-line long, so that little wings are formed at both ends of it. The dorsal valve is flatly concave throughout, without any spines.

The ventral valve is not much inflated, but its curve is very unequal in different directions. In the longitudinal direction, the valve appears considerably flattened in the apical region till about half way down to the front, when it bends suddenly, but in a well rounded curve, down to the front line. Transversely, this flattening of the apical region is less strongly marked, but then, those parts of the valve which are situated towards both ends of the hinge-line appear considerably flattened, and thus form distinct little wings. The apex is pointed but very little prominent, mostly more or less deformed, but it has never been fixed to a strange body. It is mostly slightly incurved, and thus the area, which extends below, becomes a little concave. This latter is narrow, strongly reclining, and bears a great number of very strongly imbricating striæ of growth. In the middle it is interrupted by a narrow but very highly roof-shaped pseudodeltidium, which is also provided with many imbricating striæ of growth, but which bears, as far as can be observed, no spines. The median sinus of the valve commences only at a certain, but somewhat variable, distance from the apex. The surface of the valve is covered by not very numerous, tolerably fine spines, which are arranged approximately in quincunx and are erect from their roots. On the wings they are somewhat more numerous and coarser. These spines become often astonishingly long and bend in every direction. They are never straight, and served probably for fixing the valve to foreign bodies.

The dorsal valve is flatly concave, with a very faint indication of a median fold. The apex is very strongly pointed and extremely prominent but quite flat, thus causing the pseudodeltidium of the other valve to assume the shape of a roof. The valve possessess a very narrow vertical area and thus projects like the blade of a knife over the hinge-line. This area, if quite well preserved, possesses a very neat diagonal striation, which starts from the outer and upper margin and proceeds in an oblique direction towards the hinge-line and the base of the cardinal process. The surface of the valve is entirely smooth and devoid of spines, and only a few concentric wrinkles can be observed.

The minute structure of the shell substance of both valves is very much like that of *Productus*. The shell has a dull smooth epidermis, below which follows the proper substance of the shell, which exhibits a very vivid silky lustre. If the epidermis is removed, one sees a very great number of exceedingly fine radial wrinkles, between which punctures are situated. The fine radial striation, which is drawn in the figures on Pl. LXII, is caused by this wrinkling of the deeper shell layers.

Of the interior characters of this species only those of the dorsal valve are to a certain extent known to me. The only specimen, however, in which the interior surface of the dorsal valve is exposed, shows such strange characters that I must suppose that some of them have been brought about by malformation. The cardinal process is very large and depressed, sharp on its dorsal side and broadly flattened on the ventral one. There are no distinct dental grooves at both sides of the base of the cardinal process. On the ventral side, the process is divided by a longitudinal impression, which terminates at the base in a tolerably deep roundish groove, as in most species of *Chonetes*. Below this groove a low median septum takes its origin, which is however in the specimen at my disposal split up in two—a feature that is probably not a natural one, but caused by malformation. This septum extends to not far from the frontal line. The muscular impressions, which are clearly visible, are situated on both sides of this septum. The outer pair of adductors has left large, somewhat reniform dendritic impressions, which reach far up towards the base of the cardinal process. The inner pair is enclosed between the outer pair, and immediately adjoins the median septum: but it is situated lower down, further removed from the cardinal process than the other pair, of a more narrowly elongated form, and not dendritic. The brachial ridges are not very distinct, but as far as they can be made out, they are of very strange shape. They originate on each side between the muscular impressions, and proceed, slightly ascending towards the hinge-line, to about half way from the shell margin. Then they make a nearly angular bend back, run for a short distance about parallel to the first branch, take a turn towards the front-margin, ascend again in a somewhat parabolic curve, and terminate not far from the point where they originated, in the vicinity of the median septum. The whole internal side of this valve is covered by a fine papillation, which has inadvertedly been left out in the drawing, Pl. LXII, fig. 4*a*.

The measurements of two specimens, No. I from Amb, and No. II from Chidru, are as follow:—

	I.		II.	
Entire length of the shell	41	mm.	42	mm.
Length of the dorsal valve	37	„	38	„
Entire breadth of the shell	49	„	50	„
Length of the hinge-line	45	„	33	„
Entire thickness of the shell	23	„	19	„
Distance of the two valves from each other	13	„	16	„
Apical angle of the ventral valve	141°	„	149°	„

y and geological position.—The present species is common only at a single locality, and this is Amb, where it occurs in the coaly sandstones that form the lowest fossilliferous bed of the Productus-limestone above the lavender-clays. I brought away about a dozen specimens. Except at this locality, the species has been found again only at Chidru, by Dr. Oldham; the bed this specimen came from is not exactly known, but it is probable that it came also from the lower Productus-limestone.

Remarks.—It is very easy to distinguish this species from all the others of the same genus that have been described up to the present. From *Aul. dalhousii*, in particular, it can be distinguished by its comparatively larger hinge-line, smaller area, and the less numerous and erect spines.

If we look among other genera, for shells which could possibly be related to the present species, we find *Strophalosia poyangensis*, Kays, from upper carboniferous beds of China, to be rather similar to the Indian shell. It cannot be decided from the plates alone if the Chinese species had better be retained in the genus *Strophalosia*, or if it should not rather be considered as an *Aulosteges*. No point of attachment of the ventral valve seems to exist. But even if the two shells should be found to be congeneric, yet specifically they are certainly distinct. *Stroph. poyangensis* is a much smaller form, with a finer sculpture, shorter hinge-line, and a much more transversely oval outline.

One point in the structure of the Indian species is of special interest,—this is as to how the valves opened. The point on which the dorsal valve turned when the animal opened its shell was the extremity of the apex of this valve, which is strongly prominent, entirely attached to the cardinal process, and sticks firmly to the roof-shaped pseudodeltidium of the other valve, which is closed nearly quite down to the hinge-line. Owing to this arrangement the valve could not have turned without a slight shifting of the whole hinge-line in a vertical direction, and without a sliding backward of the two thickened projecting shell corners on both sides of the deltidial fissure, which fitted into the large roundish grooves on both sides of the cardinal process without filling them up. Thus it happened that in the position when the valves were opened, the upper margin of the dorsal area was functioning as hinge-line. It is also very remarkable that just in this species, where an opening of the valve was only possible under very peculiar circumstances, the dorsal area possesses a diagonal striation, which bears a striking resemblance to the striation occurring on the valves of the Pelecypoda at the place where the ligament is inserted.

I have thought it not superfluous to draw the attention of men of science to this circumstance, as it would be very desirable that further observations in a similar direction should be made on other shells.

I have given the name of *Aulosteges medlicottianus* to this shell in order to express once more my utmost gratitude to Mr. H. B. Medlicott, the Superintendent of the Geological Survey of India, for the great kindness and untiring zeal with which he has now conducted for years the publication of the present work.

Genus: PRODUCTUS, Sowerby.

This genus is among all the fossils of the Salt-range most numerously represented; I count altogether not less than twenty species of it. Not only are the specific forms so very numerous, but the individuals also occur in the greatest profusion, and in some beds scarcely can any piece of rock be picked up in which one or the other specimen of the genus would not be contained. It was for this reason that I chose the name of "Productus-limestone" for the whole formation.

The genus *Productus* is very well known to everybody, and it seems hardly necessary to repeat here again the already often described generic characters, more especially as I have nothing new to add to them. I have only slightly restricted the genus, inasmuch as I have separated from it those forms which bear in each valve, not far from the margin and parallel to it, a projecting shelly ridge, which is sometimes crenulated on top. I unite these forms under the name of "*Marginifera*," and consider *Productus longispinus*, Sow., also as probably belonging to this genus, though it has the character not yet well developed. All the shells belonging to my new genus are of small size.

Even in this restricted sense there are nevertheless twenty different species that can be attributed to the genus. Seven different species of *Productus* from the Salt-range have been described by Davidson; these are—1, *Productus striatus*, Fisch.; 2, *Productus longispinus*, Sow.; 3, *Productus cora*, Orb.; 4, *Productus semireticulatus*, Mart.; 5, *Productus costatus*, Sow.; 6, *Productus purdoni*, Dav.; and 7, *Productus humboldti*, Orb. I am, however, very sorry to say that I can accept but few of these names. Firstly, *Productus longispinus* must be removed from the list; as all the forms more or less allied to Sowerby's species occurring in the Salt-range belong to the genus *Marginifera*, and will be treated of later on in this work. With regard to the other species, I must confess that I am inclined to draw the limits of the several species much closer than Mr. Davidson has done, and also closer than Mons. de Koninck has proposed to do. The descriptions of the species in the works of Mons. de Koninck as well as of Mr. Davidson have all been drawn up under the impression that the marine carboniferous species all came from about the same geological horizon,—that is, the mountain-limestone,—and that the marine carboniferous beds of Russia and other countries were not much different in age from those of England and Belgium. In the meantime, Mr. Moller, in a paper of the utmost importance, has shown that the Russian marine beds as well as those of other countries belonged to very different geological horizons,—as different, for instance, as the several sub-divisions of the trias in Southern Europe. While, then, the first of the two views indicated tended to contract the different shapes of Brachiopod shells as far as possible into one species, as of not very much differing geological age, the other takes the very different geological age of the different shapes also into consideration, and must thus arrive at a much closer distinction of the species than would otherwise be the case. I am in this latter position, and must break up the developmental lines of forms, which have all been contracted into one species by Koninck and Davidson, into the several composing members; thus I shall frequently have to apply other names to the Salt-range species than those given by Mr. Davidson. In most cases what is a species for Mr. Davidson is a group of forms for me, but as I always employ the name of the group as heading, it will not be difficult for those who may not agree with my views to reduce them to the opinions of Mr. Davidson.

The grouping of the species of *Productus* has been executed in the most admirable manner by Mons. de Koninck, and in all cases it is most easy to distribute the Salt-range forms into Koninck's groups. Only one of Koninck's groups or sub-divisions I should like to split up into two, namely, that of the "*Striati*," which comprises regular forms like *Prod cora*, Orb., and *Prod. giganteus*, Mart., as well as the very irregular *Prod. striatus*, Fisch. Now this latter I should like to remove from the group and introduce the designations of "*Lineati*" for the regular forms and "*Irregulares*" for *Prod. striatus* and allies.

If we now go through the different species of *Productus* occurring in the Salt-range, according to the sub-divisions to which they belong, we must begin with the *Lineati* which includes *Prod. cora*. As it seems to me, very different things have been considered as belonging to this species. On a first view, we can distinguish two large groups among the forms that are generally called *Prod. cora*: one group with a median impression on the visceral part of the ventral valve, the group of *Prod. neffedievi*, Vern., and another group without such an impression, that of *Prod. cora* proper. Each of these groups, however, can again be sub-divided, as it appears to me, into several mutations according to the geological age of the different forms. That the two groups must be considered as distinct has been recognised already by M'Coy and Moller; and notably the latter has not introduced *Prod. neffedievi* among the synonyms of his *Prod. cora.*

In the group of *Prod. neffedievi,* the geologically oldest shape which apparently occurs in the mountain-limestone proper is the typical form which has been figured so excellently by Verneuil (Geol. of Russia, Vol. II, pl. 18, fig. 11) and Koninck (Monogr. d. gen. Prod. et Chon., pl. 5, fig. 2 *d. e.*). This species is characterised by the general absence of spines on the surface of the ventral valve, except along the hinge-line, where apparently two rows of small spines are generally developed. It seems that this form is almost entirely restricted to eastern districts, and is, if not entirely absent, yet very rare in Western Europe. In the upper carboniferous limestone of Russia, chiefly at Mjatchkowa near Moscow, another shape occurs, which has been excellently figured by Trautschold (Mjatchkowa, pl. 5, fig. 1). In this shape scattered spines are generally developed on the surface of the ventral valve, and the hinge-line also bears one or two rows of little spines. This same form occurs in great numbers in the Salt-range. It bears, like the Russian shell, scattered spines on the ventral valve and spines along the hinge-line. I distinguish this form under the name of *Prod. lineatus*, W.

The other group of forms, of which *Prod. cora*, Orb., forms part, has in general a more westerly distribution than the preceding one. The geologically oldest shape of that group is *Prod. corrugatus*, M'Coy, from the mountain-limestone of England and Belgium. Most authors have united this species with *Prod. cora*, but I think it must be kept separate, as in this species by far the majority of specimens is without scattered spines on the surface of the ventral valve, and only in certain rare variations do such spines occur. This shape has been excellently figured by Davidson (Mon. Brit. Carb. Brach., pl. 36, fig. 4, and pl. 42, fig. 9) and Koninck (Mon. gen. Prod. et Chon. pl. 5, fig. 2 *a. b. c.*). The hinge-margin is in this form always provided with numerous spines. In the coal-measures of North and South America, another form occurs, in which the scattered spines on the ventral valve are *never* absent, and in which they occur often in great numbers. This latter form only, I think, must be considered as representing the true *Prod. cora*, Orb. The species has been found also in the Salt-range, but it is very rare there. In America, this species is generally quoted under the name of *Prod. prattenianus,* Norw. and Pratt.

The second of Mons. de Koninck's sub-divisions, of which species occur in the Salt-range, is that of the *Semireticulati,* and it must be remarked that the greatest number of individuals of the genus is furnished by this sub-division. Mr. Davidson has described two species belonging to it,—*Prod. semireticulatus,* Mart., and *Prod. costatus,* Sow. With regard to the first of these two species, I must be somewhat doubtful whether Mr. Davidson had really the *Prod. semireticulatus* from the Salt-range before him, when quoting this species, as *Prod. semireticulatus* is so very rare there that only a single very badly preserved specimen of the species has been obtained up to the present. It is on the other hand probable that

Mr. Davidson has included other forms, which are far more common, but which, according to my views, should be separated from Martin's species, and which I shall describe further on under the name of *Productus spiralis*, W. Another allied form will be described as *Productus aratus*, W. I am in a very similar position with regard to *Prod. costatus*, Sow. The European species is always rather small, not very coarsely ribbed; the most striking character, however, consisting in two thick ribs, which cover the wings of the ventral valve. These ribs, with the strong spines on them, are present in nearly all the specimens, and among a good set of this species contained in the Hof-Mineralien-Cabinet at Vienna, there is not a single specimen without these ribs. The European specimens without the thick lateral folds must be considered as exceptions, which must be traced probably from other sources and might perhaps best be considerd as bastard forms between *Prod. costatus* and *Prod. semireticulatus*. In the Indian shell, which has been identified by Mr. Davidson with *Prod. costatus*, these thick lateral folds are *never* present, and the shell is altogether of a larger and clumsier shape than *Prod. costatus*. I shall call the Indan form *Prod. indicus*, W. At the side of this species another occurs with somewhat finer ribs, which will bear the name of *Prod. subcostatus*, W., and a third with a nearly smooth shell, which will be described under the name of *Prod. vishnu*, W.

With these two groups of forms the species of the *Semireticulati* occurring in the Salt-range are not yet at an end. There is still a very elegant little *Productus*, which I consider as nearly related to *Prod. portlockianus*, Norw. and Pratten. This latter species has been considered by many writers as a synonym only of *Prod. costatus*, but I think it is distinct by its more equal ribs, deeper and sharper median sinus, and smaller size. In all these characters the Indian shell agrees with this American species, but it is yet smaller, the ribs are finer and higher, and thus I must distinguish it under a new name, which will be *Prod. gratiosus*, W. It might perhaps be compared also to *Prod. griffithianus*, Kon.

The third sub-division of Mons. de Koninck, the *Spinosi*, is but very sparingly repesented in the Salt-range. I can place only a single species in this sub-division, and this is rather nearly related to *Prod. muricatus*, Phill., and will bear the name of *Prod. asperulus*, W.

The "*Fimbriati*" occur again in rather large numbers in the Salt-range, and the most important group among them is the group of *Prod. humboldti*, Orb. This latter species itself is rather rare in the Salt-range; so much the more common, however, is another species, which is very nearly related to the preceding one, but distinguished by a coarser granulation, and which will receive the name of *Prod. abichi*, W. Other species belonging to the group, but of less importance, are *Prod. serialis*, W., and *Prod. cylindricus*, W. The group of *Prod. pustulosus*, Phill., is represented by *Prod. bhalensis*. W. Lastly, an isolated species, belonging to the sub-division, is *Prod. purdoni*, Dav.

The "*Horridi*" are but very little developed, whilst the "*Caperati*" are entirely absent. Of the *Horridi* there exists a little spieces, which is very nearly related to

Prod. geinitzianus, Kon., but which yet cannot be identified with that species. It will bear the name of *Prod. opuntia*, W. Another species, also probably belonging to the *Horridi*, appears to bear rather a close likeness to *Prod. kiangsiensis*, Kays, from the upper-carboniferous beds of Lo-Ping in China. Nevertheless I cannot identify the two forms on account of a somewhat different sculpture and a different development of the wings in the Indian shell, and thus this latter will have to take a new name, and I shall call it *Prod. tumidus*, W.

Lastly, the section "*Irregulares*" consists only of shells more or less nearly related to *Prod. striatus*, Fisch. I know that I shall meet with the approval of but very few men of science, when I distribute the forms which are generally considered as composing the species *Prod. striatus*, into several specific groups; and yet I cannot but proceed in the manner indicated. The shells which have been described from the Salt-range under the name of *Prod. striatus* are, to me, distinguishable from the European shell which bears this name, and I must express this distinctness in the name. There are two forms of the group of *Prod. striatus* in the Salt-range. The one has large but depressed wings, so that these latter do not extend approximately in the plane of the valve, but are bent down forming one plane with the lateral descending parts of the apex. This species I shall call *Prod. compressus*, W. The other form is not accidentally but really without wings, and has no hinge-line at all; I shall call it *Prod. mytiloides*, W.

With these latter two species the number occurring in the Salt-range is at an end.

It will be necessary, in order to make a general view of these scattered notices of the affinities of the Salt-range species more easy, to give a classified list of these forms. I have accordingly drawn up the following scheme: —

I.—Section Lineati.

a.—Group of Productus nefedievi, Vern.
    1.—Prod. lineatus, W.

b.—Group of Productus corrugatus, M'Coy.
    2.—Prod. cora, Orb.

II.—Section Semireticulati.

c.—Group of Productus semireticulatus, Mart.
    3.—Prod. semireticulatus, Mart.
    4.— ,, *spiralis*, W.
    5.— ,, *aratus*, W.

d.—Group of Productus costatus, Sow.
    6.—Prod. subcostatus, W.
    7.— ,, *indicus*, W.
    8.— ,, *vishnu*, W.

e.—Group of Productus portlockianus, Norw. and Pratt.
    9.—Prod. gratiosus, W.

III.—Section Spinosi.

f.—Group of Productus muricatus, Phill.
10.—Prod. asperulus, W.

IV.—Section Fimbriati.

g.—Group of Productus humboldti, Orb.
11.—Prod. humboldti, Orb.
12.— „ *abichi*, W.
13.— „ *serialis*, W.
14.— „ *cylindricus*, W.

h.—Group of Productus pustulosus, Phill.
15.—Prod. bhalensis, W.

i.—Isolated species.
16.—Prod. purdoni, Davids.

V.—Section Horridi.

k.—Group of Productus geinitzianus, Kon.
17.—Prod. opuntia, W.

l.—Group of Productus kiangsiensis, Kays.
18.—Prod. tumidus, W.

VI.—Section Irregulares.

m.—Group of Productus striatus, Fisch.
19.—Prod. compressus, W.
20.— „ *mytiloides*, W.

To many it will appear very strange that in this long list only a single species is quoted which occurs also in Europe, and among the whole there are only four, which have been described previously. This result differs widely from what one is wont to see among the *Producti*. In the *Producti* more than in any other group of the Brachiopoda transitional shapes between the several forms occur, and the species are generally taken as having a wider range than those of other groups, their variability being extreme. It will be understood that I cannot here go into details with regard to the European species, though as to them also opinions have been uttered, for instance by Beyrich, that Messrs. Koninck and Davidson had gone too far in uniting different shapes into one species; but with regard to the Indian forms I must keep things more apart than has generally been done in Europe. The circumstance that we were so very long entirely in the dark as to the general classification of the carboniferous rocks is due in great measure to the very insufficient distinction made among the species of Brachiopoda; and if a satisfactory discrimination of the several marine carboniferous beds is ever accomplished, it will certainly be found that different shapes are also restricted to different beds. The transitional forms that no doubt exist are partly due to the development in time of the different species, although partly also no doubt to hybridity, as I have indicated already in describing the *Terebratulidæ*. The hybridity will the more frequently occur as the different forms are more nearly related. It seems, however, not practical to lay too great stress on such intermediate forms, but rather the contrary. We will then only arrive at a right understanding of the historical development of the different shapes, by fixing strictly the more constant and frequently occurring forms by separate names, rather than by mingling up different things only for the reason that here and there transitional forms can be observed. Starting from such considerations, I have thus arrived at founding so many new species on the one hand, and on their distinction from the related European forms on the other. The reason why all these forms can be distinguished specifically from all the species that have been described up to the present by other authors, rests probably on two circumstances—first, that the great mass of described *Producti* came from truly carboniferous beds, be it from the mountain-limestone or from the coal-measures; and second, that the Salt-range beds have for the greater part an age different from both.

The geological distribution of the Salt-range species is very variable; some of them are restricted to a single bed, others again extend through the whole Productus-limestone formation. I think it will be best to give here a list of the species with the horisons in which they occur. In this list, Low.=Lower Productus-limestone, Midd.=Middle Productus-limestone, and Upp.=Upper Productus-limestone; Ceph. bed, signifies the Cephalopoda-bed of the Upper Productus-limestone. Thus the distribution of the several species is as follows:—

1. *Prod. lineatus*, W., Midd. and Upp., common.
2. „ *cora*, Orb., Low. Midd. and Upp., rare
3. „ *semireticulatus*, Mart., Low., very rare
4. „ *spiralis*, W., Low., common.
5. „ *alatus*, W., Ceph. bed, rare.
6. „ *subcostatus*, W., Midd. and Upp., rare.
7. „ *indicus*, W., Midd. and Upp., very common.
8. „ *vishnu*, W., Midd., very rare.
9. „ *gratiosus*, W., Midd., common; Upp., rare.
10. „ *asperulus*, W., Midd., rare; Upp., common.
11. „ *humboldti*, Orb., Midd., rare.
12. „ *abichi*, W., Midd. and Upp., common.
13. „ *serialis*, W., Ceph. bed, rare.
14. „ *cylindricus*, W., Ceph. bed, rather rare.
15. „ *bhalensis*, W., Low., rare.
16. „ *purdoni*, Davids., Upp., not rare.
17. „ *opuntia*, W., Ceph. bed, rare.
18. „ *tumidus*, W., Midd., rather common; Upp., rare.
19. „ *compressus*, W., Midd., not rare.
20. „ *mytiloides*, W., Ceph. bed, very rare.

It appears from this list that the chief mass of species of *Productus* occurs in the middle Productus-limestone; that the lower Productus-limestone is not very rich in species, but that those that occur are nearly all peculiar; and that in the upper Productus-limestone the Cephalopoda-bed has the greatest number of peculiar species.

1.—SECTION: LINEATI.

a.—GROUP OF *PRODUCTUS NEFFEDIEVI*, Vern.

1. **PRODUCTUS LINEATUS**, Waagen, n. sp., Pl. LXVI, figs. 1, 2, Pl. LXVII, fig. 3.

1862 *Productus cora*, (Orb.) Davidson, Quart. Journ. Geol. Soc., Lond., Vol. XVIII, p. 31

1863. *Productus cora*, (Orb., Davids.) Koninck. Foss. paléoz. de l'Inde, p. 38

1876 *Productus cora*, (Orb.) Trautschold. Die Kalkbrüche von Mjatschkowa. II, page 53. pl. V, fig. 1, (Syn. exclus.)

The general outline of this species is mostly elongately oval, longer than it is wide, with a strongly prominent and bent-over apical region. The dorsal valve is not very deeply concave. The sculpture consists of fine radiating striæ, which are interrupted from time to time by not very strong erect spines.

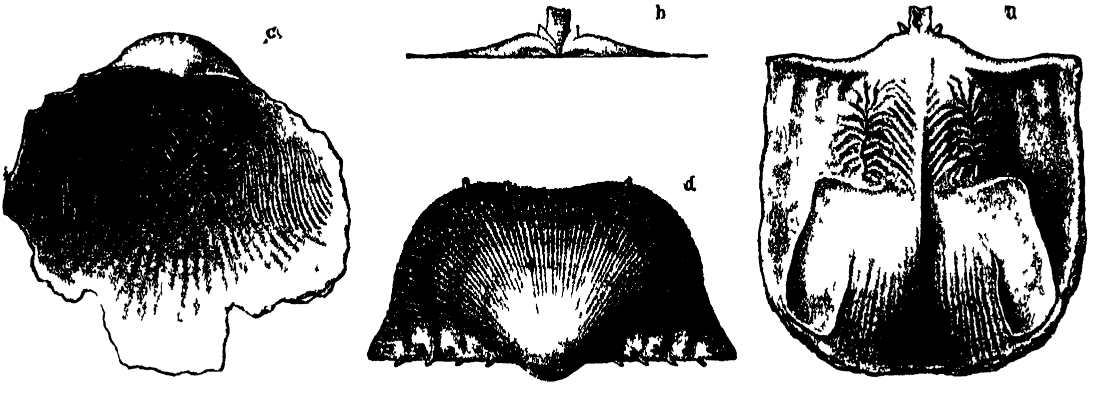

Fig. 21. *Productus lineatus*, W., n. sp. *a. b. c.* silicified specimen from Musakheyl—*a.* dorsal valve, interior view. *b.* view of the cardinal process and hinge-line from the outer or dorsal side, *c.* ventral valve of the same specimen internal view, all natural size, *d.* cardinal view of a specimen from the road between Vurcha and Uchháli, to show the spines along the hinge-line natural size.

The ventral valve is very strongly inflated, and it is equally strongly vaulted in both directions. Only, towards the ends of the hingeline it is somewhat flattened, thus forming little spread-out wings. The hingeline is long and straight; but in most cases it is not quite so long as the greatest breadth of the shell. The pointed and very strongly enrolled apex distinctly bends down over it. Not far from the apex, a broad distinct flattening, or impression, appears on the very prominent median part of the ventral valve, and extends as far as the visceral part; lower down, however, it disappears again entirely. The sculpture consists of numerous fine radiating striæ, which remain of very equal thickness for their whole extent, and augment at intervals by intercalation of new ones. There are, very regularly, 7 or 8 striæ within the space of 5 mm. The striæ are interrupted at intervals by the bases of strong erect spines, in which generally three or four striæ unite, and which thus cause locally a strong deviation of the otherwise straightly descending striæ. These spines are irregularly distributed over the median part of the valve and are rather variable in number, but never very profusely developed. Along the hingeline one or two rows of smaller spines, very irregular in number, are present. The wings are ornamented with strong concentric folds, which are almost entirely restricted to them or only ascend for a very short distance the lateral parts of the median shell portion. The margins of the valve, if entirely preserved—though this is only rarely the case—are not in one plane, but have the lateral parts descending and expanding considerably below the level of the hinge-line, in the same manner as has been described by Trautschold from Moscow specimens.

The dorsal valve is flatly concave in the visceral region, and, when entirely preserved, somewhat geniculated towards the margins. It is most regularly hollowed out in the vicinity of the apex, while the wings are rather flatly spread out. Lower down a very distinct median fold is developed, which is limited on both sides by elongated, deeply excavated spaces. The geniculated part of the valve is again regularly concave. This valve is also ornamented with a very regular fine radial striation, which is, however, rather indistinct on the wings. The striæ are of the same breadth as on the other valve, augment also by intercalation, but are not interrupted by spine-bases, spines being entirely absent in this valve. Instead, a distinct concentric sculpture is developed. This commences on the wings with strong descending folds, which are, however, separated from the hingeline by a smooth excavated space. Of these folds, there are about eight present on each side. They bend round, following approximately the contour of the shell-margin, and unite with the folds of the other side.

The interior characters of the shell are pretty completely known to me. In the ventral valve the muscular impressions are of quite an extraordinary size. The four adductor impressions, as well as the divaricators, are clearly distinguishable. Of the adductors, two large dendritic impressions are situated not far from the apex on both sides of the middle line of the valve, and two quite small ones can be observed at the base of the former and somewhat between them. They are not dendritic. The divaricator impressions are outside the adductors and somewhat lower down. They are very large, of a somewhat broadly reniform shape and strongly striated vertically. The remaining space of the visceral part of the valve, below the muscular impressions, shows shallow radiating furrows which sometimes bifurcate: these might perhaps be explained as impressions of the vascular system.

The dorsal valve is less exactly known to me in its internal characters than the other one, as the space outside the brachial ridges is broken away in the specimen I have for observation, and thus nothing is known to me of possibly occurring vascular impressions, &c. The cardinal process of this valve is comparatively small and little prominent. It is deeply tripartite, the median part being largest, rectangular in shape, and bearing a deep groove on its interior face. The process is supported by a thick callous shelly mass, which forms the upper end of the valve, and is continued along the hinge-margin as thick rounded ridges. Also in the direction of the middle line of the valve it forms sometimes a thick broadly rounded ridge, which then forms more or less the continuation of the cardinal process. Out of this ridge lower down a high and sharp median septum is produced, extending for about two-thirds of the length of the visceral part of the valve. Where the thick ridge, above mentioned, is absent, the cardinal process is separated from the median septum by an elongated smooth space. The muscular impressions, which are broad but not very long, commence about where the median septum begins. The two pairs of adductor impressions cannot well be distinguished, all forming one large dendritic mass ; it seems, however, that an obliquely striated inner part of the impression belongs to the inner pair, whilst an irregularly dendritic larger outer part may be considered as being produced by the outer pair. The brachial ridges originate at the base between the two pairs of muscular impressions. They first extend outward, slightly ascending, then suddenly bend down and extend in this way, directed slightly outward, for a rather long distance, and at last they turn again inward and upward, and terminate far distant from each other and from the termination of the median septum. The thorns, which generally ornament the inside of the *Productus* shells, seem to be absent in this species.

The species varies to a certain extent, inasmuch as the general outline is sometimes narrowly elongated, sometimes broadly oval. This variation is chiefly due to two circumstances. First, it depends upon the more or less strong development of the wings, which are sometimes rather large and strongly projecting, while they are very small in other cases; and second, from the more or less entire preservation of the " trail," as it as been called,—that is, the part of the shell which is beyond the visceral portion and where the two valves run parallel and nearly touch each other. Another point of variation is in the spines, which are situated along the hingeline. These are sometimes numerous (10 to 12 on each side of the apex) and then arranged in two irregular rows, sometimes they are scarce or seem to be even entirely absent. It must, however, be remarked that these spines are very easily lost by the process of fossilisation, a circumstance which is not the case with the spines scattered over the surface of the ventral valve.

It is barely possible to give exact measurements of this species of *Productus* as the dimensions vary exceedingly with the mode of preservation of the several specimens, and thus exact measurements are of no use for comparison. The largest specimen known to me is 76 mm. in length and 67 mm. in breadth ; its thickness is 53mm. Average-sized specimens have generally 60 mm. in length and 48 to 55 mm. in breadth. The apical angle varies between 85 and 105 degrees. The distance of the two valves in the visceral region is about 30 to 35 mm.

Locality and geological position.—The present species is rather common in certain beds of the Productus-limestone. It commences already in the lower division of the formation, but is very rare there. A single specimen was detected by Dr. Oldham at Chidru in a yellowish-grey sandstone rather low in the series. In the middle division the species has its chief development. It has been found in these beds by all who have visited the Salt-range, and is preserved in the collections from the following localities: E. of Katwáhí (2 sp.), N. of the same place (1 sp.); Khura (4 sp.); Khura top beds of the middle division (1 sp.); Khund Ghât (7 sp.); Morah (4 sp.); Virgal (2 sp.); Vurcha (3 sp.); road from Vurcha to Uchâli (7 sp.); Musakheyl (2 sp.); Chidru (3 sp.); Káfirkot (6 sp.), Káfirkot North (2 sp.); Paniála cliffs Shekh Budín (2 sp.).

In the upper division of the Productus-limestone the species is somewhat rare. It has been found in these beds by Mr. Wynne at Katwáhí (2 sp.) and at Khund Ghat (1 sp.); and by me on the road between Katwáhí and Shahpur (2 sp.), at Jabi in the *Cephalopoda*-bed (2 sp.), and somewhat lower down (1 sp.), at Chidru in the *Cephalopoda*-bed (1 sp.), and in the section west of Khura, at the base of the upper division.

Remarks.—The occurrence of this species in India is of very high geological interest. As to the identity of the Indian shells with the European one that has been figured by Trautschold, there can, I think, be no manner of doubt. It needs only a comparison of the figures given by me with Trautschold's drawings, to become convinced of the matter. 'Another question is its distinction from *Prod. cora*, Orb., as these forms are called generally, or from *Prod. neffediewi*, Vern., more especially. I have already stated in the introduction to the genus that, according to my views, the shells which are generally called *Prod. cora* should be divided into two series of forms, one with a median sinus in the visceral region and another without such a sinus. Both of these series have representatives already in the mountain-limestone proper, but these geologically older shells are generally devoid of scattered spines on their shell surface, whilst they bear spines along the hingeline. The absence of spines on the surface of the shell is certainly not entirely due to the preservation of the shell, as has been suggested for *Prod. neffediewi*, by Mons. de Koninck, or else the spines along the hingeline would also be absent. The nearly entire absence of surface-spines is certainly a specific character, and thus the forms with a sinus (*Prod. neffedewi*, Vern.) as well as those without it (*Prod. corrugatus*, M'Coy) must be considered as constituting separate species.

In the upper-carboniferous beds, the upper-carboniferous limestone of Russia, the coal-measures of America, &c., forms with surface-spines occur exclusively. Of shells with a sinus two varieties occur. One of them is that described here under the name of *Prod. lineatus*, W. It is characterised by an elongated general outline, scattered surface spines of varying number, and strong concentric folds on the wings. Another form has been described from the coal-measures of western North America by Meek under the name of *Prod. multistriatus*. It is distinct from *Prod. lineatus*, by a more transverse general outline, a deeper sinus and the absence of concentric folds on the wings. Very nearly related to this American shell are *Prod. impressus*, Toul., and *Prod. weyprechti*, Toul., from permo-carboniferous beds of Spitzbergen. Our *Prod. lineatus* can be distinguished from these by the same characters by which it differs also from *Prod. multistriatus*, Meek.

The forms without a sinus constitute *Prod. cora*, and allied species.

The vertical geological distribution of the several forms is rather large.

The forms without surface-spines seem to go through all the different sub-divisions of the lower-carboniferous, whilst the forms with surface-spines are scattered through the whole of the upper division of the carboniferous formation, without its being possible to distinguish specifically between the forms collected at different horizons. It is a feature which will yet often occur to us in the description of the species belonging to the genus *Productus*, that the species of this genus have a more extensive vertical geological distribution, and that they are not so apt for the characterisation of more minute geological horizons as of larger divisions. For this latter purpose they are often of the utmost value.

b. Group of *PRODUCTUS CORRUGATUS*, M'Coy.

2. Productus cora, Orbigny. Pl. LXVI, fig. 3; Pl. LXVII, figs. 1, 2.

1842. *Productus cora*, D'Orbigny: Voyage dans l'Amérique Méridionale, tome III, 4me partie: Paléontologie, p. 55, pl. V, figs. 8-9.

1852. *Productus cora*, (Orb.) Owen: Geol. Rep. on Wisconsin, Iowa and Minnesota, pp. 103 and 136, pl. 5, fig. 1.

1852. *Productus semireticulatus*, (Mart.) Hall: Stansbury's Rep. Salt Lake Exp., p. 411, pl. III, figs. 3-5.

1854. *Productus prattenianus*, Norw. and Pratten: Journ. Acad. Nat. Sci. Philadelphia, 2 series, Vol. III, p. 17, pl. I, fig. 10.

1855. *Productus aequicostatus*, Shumard: Geological Report, Missouri, p. 201, pl. C, fig. 10.

1858. *Productus cora*, (Orb.) Marcou: Geology of North America, p. 45, pl. VI, fig. 4.

1866. *Productus flemingi*, (Sow.) Geinitz: Carbon. u. Dyas in Nebrasca, p. 52, pl. IV, figs. 1, 2, 3, 4.

1871. *Productus prattenianus*, (Norw.) Meek and Hayden: Final Report on Nebraska, p. 163, pl. II, fig. 5; pl. V, fig. 13; pl. VIII, fig. 10.

1874. *Productus cora*, (Orb.) Derby: On the Carboniferous Brachiopoda of Itaituba, Bull. Cornell Univ., Vol. I, No. 2, p. 49, pl. II, fig. 17; pl. VI, figs. 17.

1875. *Productus prattenianus*, (Norw.) White: Wheeler's Geogr. and Geol. Expl. west of the 100th Meridian, Vol. IV, pl. I; pl. VII, fig. 1.

1877. *Prod. prattenianus*, (Norw.) Meek: King's Geol. Expl. of the 40th Parallel, Vol. IV, p. 72, pl. VII, fig. 7.

The general outline of this species is elongately to transversely oval. The ventral valve is moderately convex, with a not very strongly prominent apical region. The dorsal valve is not very deeply concave, geniculated. The sculpture consists of a fine radial striation, with tolerably numerous scattered spines on the surface of the ventral valve.

The curve of the ventral valve is rather different in different specimens. In some the apical region is somewhat flattened in the longitudinal direction, whilst it is regularly vaulted in others. In the transverse direction the curve is everywhere regular. The lateral parts along the hingeline are flattened and form rather largely spread-out wings, which are however rarely entirely preserved. The hingeline is as long or slightly shorter than the greatest breadth of the shell. The apex is nearly always strongly enrolled, slightly prominent, pointed, and generally overhangs the hingeline a little. The wings are flatly spread out, and bear not very strongly developed concentric folds or wrinkles, of which there are about four or five on each wing. When the valve is entirely preserved, it possesses a well-developed trail, which is in some cases spread out all round the shell, but which mostly does not deviate from the general curve of the valve. The sculpture of the valve consists in fine radiating ribs, which are separated from each other by equally broad interstices. The striæ are nearly of equal breadth for the whole length, and vary in this respect only so far, that there are seven of them within the space of 5 mm. not far from the front margin, while there are ten within the same space in the vicinity of the apex. From distance to distance this striation is interrupted by the bases of strong erect spines which are irregularly disseminated over the surface of this valve. Their number is rather large; I counted 24 such spines on a specimen from Jabi. At the base of these spines four to six of the longitudinal striæ unite. Along the hinge-margin also numerous spines exist which are, however, smaller than the others.

The dorsal valve is not very deeply concave in the visceral part, and geniculated where the trail commences. The wings are large and quite flattened, separated from the remainder of the valve by barely perceptible rounded ridges, which diverge from the apex to the lateral parts of the shell. The sculpture of the valve consists of radial striæ of the same character as those of the other valve. Of scattered spines, or grooves corresponding to the spines of the other valve, nothing can be seen. Besides this radial sculpture there is also a concentric one, consisting of rather irregular concentric folds or wrinkles, which are apparently sometimes in connection with somewhat imbricating or even lamellar striæ of growth.

The internal characters of this species are not known to me.

The size of the species is moderate; it seems not to become as large as *Productus lineatus.* The visceral part of a full-grown specimen is about 55 mm long, 50 mm. broad, and 30 mm. thick. The distance of the two valves from each other is about 23 mm.

Locality and geological position.—This species is extremely rare in the Salt-range, though it occurs off and on through the whole vertical extent of the Productus-limestone formation. Most numerously I found the species in a reddish sandstone at the very base of the fossiliferous part of the Productus-limestone at Katta (bed No. 9 of my note-book). The specimens are mostly very badly preserved, but I brought away four, tolerably well preserved and well determinable. In the middle division of the Productus-limestone the species has been detected up to the present only trans-Indus; Mr. Wynne brought one specimen from Omarkheyl and one specimen from Shekh Budín. The upper division has furnished two specimens at Jabi, where they occurred in the *Cephalopoda*-bed.

Remarks.—I must at first say some words about the name I apply to this species. The original figure of the species, as given by D'Orbigny in his Voyage dans l'Amérique Méridionale, cannot possibly be correct. The wings as they are drawn could never occur in any *Productus;* they are represented like the wings of a *Janira* or some such form. If then we consider the figure, we must ignore the wings entirely, and notice only the body of the shell in comparing the figure with other species. Now Mons. de Koninck tells us, after inspection of the original specimen, that *Productus cora* is in every respect identical with *Productus corrugatus,* M'Coy, with the sole exception that the surface is spiny, whereas in the European shell it is generally devoid of spines. That Mons. de Koninck does not think this difference to be of sufficient importance to distinguish specifically between the American and the European forms, does not materially influence the question. We know from Mons. de Koninck's observation, which is not directly contradicted by D'Orbigny's figure, how to interpret that figure, and from such an interpretation it devolves necessarily that the form described by American writers generally under the name of *Productus pratteniamus*, Norw., is identical with *Productus cora*, Orb. A further argument in the matter can be drawn from Mr. Derby's statement, that the beds in which *Productus cora* at Yarbichambi occurs are to all appearances of the age of the coal-measures.

Thus the true *Productus cora* would be constituted of those forms which have been called in North America *Productus prattenianus*, but it would be entirely absent in Europe and the adjacent countries. Of European forms which approach very nearly *Prod. cora*, one must chiefly be mentioned, that figured by Möller from the upper carboniferous-limestone of the Ural under the name of *Prod. cora*, Orb. (Mining Journal of St. Petersburg, 1862, p. 179, pl. IX, fig. 3), and of which somewhat smaller specimens subsequently received the name of *Prod. riparius* from Trautschold. Though the latter author affirms in his description of the species that there were no scattered spines on the surface, yet he draws three spine bases on the figure of his original specimen. This *Productus riparius*, Trautsch., very likely replaces the *Productus cora* in the upper-carboniferous beds of Europe, and can be distinguished from the latter species by its flat (not enrolled) form, pointed and prominent beak, and the median impression far away from the beak, as in most specimens;—such are the characters as far as can be judged from drawings and descriptions, no specimens being at my disposal.

Less nearly related is *Productus corrugatus*, M'Coy. I have already stated above that I consider this species as distinct on account of the general absence of spines on the surface, whereas these spines are *never* absent in *Prod. cora*. Otherwise *Prod. corrugatus* shows the same configuration and the same inflation of the ventral valve.

A whole group of forms in outward appearance having a certain similarity to *Prod. cora* has lately been made known by Dr. Stache from carboniferous beds of the Sahara. The chief representative of this group is *Prod. africanus*, Stache. The internal characters of these forms are however so peculiar that it will probably prove necessary in time to create a proper genus for their reception. They need not then be compared more particularly with *Prod. cora* and its allies.

II.—SECTION SEMIRETICULATI.

c. GROUP OF *PRODUCTUS SEMIRETICULATUS*, Mart.

3. PRODUCTUS SEMIRETICULATUS, Mart.

1847. *Productus semireticulatus*, (Mart.) Koninck: Monogr. des genres Productus et Chonetes, p. 83, pl. VIII, fig. 1; pl. IX, fig 1; pl. X, fig. 1.

1862. *Productus semireticulatus*, (Mart.) Davidson: Quart. Journ. Geol. Soc., Lond., Vol XVIII, p. 31.

1863. *Productus semireticulatus*, (Mart. Davids.) Koninck: Foss. paléoz. de l'Inde, p. 38.

1863. *Productus semireticulatus*, (Mart.) Davidson: Monogr. of Brit. Carb. Brach. p. 149, pl. XLIII, figs. 1-11; pl. XLIV, figs. 1-4.

1866. *Productus semireticulatus*, (Mart.) Davidson: Quart. Journ. Geol. Soc., Lond., Vol. XXII, p. 43, pl. III, fig. 12.

1871. *Productus semireticulatus*, (Mart.) Quenstedt: Petrefactenkunde Deutschl. Abthlg. I, Vol. II, p. 621, pl. XXVIII, figs. 29-41.

1871. *Productus semireticulatus*, (Mart.) Meek and Hayden: Final report on Nebraska, p. 160, pl. 5, fig. 7.

1874. *Productus semireticulatus*, (Mart.) Derby: Bull. Cornell Univ., Vol. I, No. 2, p. 47, pl. IV, fig. 8; pl. VI, fig. 18; pl. VII, figs. 5, 6, 7, 15, 16.

1877. *Productus semireticulatus*, (Mart.) Meek: Clarence King's Geol. Explor. of the 40th Parallel, Vol. IV, p. 69, pl. VII, fig. 5.

1883. *Productus semireticulatus*, (Mart.) Kayser: Obercarbonische Fauna von Lo-Ping, in Richthofen's China, Vol. IV, p. 181, pl. XXV, figs. 1-4 and 7.

I have given here only a few of the quotations which might be given with respect to the present species, but those adduced are sufficient to show what I mean to understand by the name.

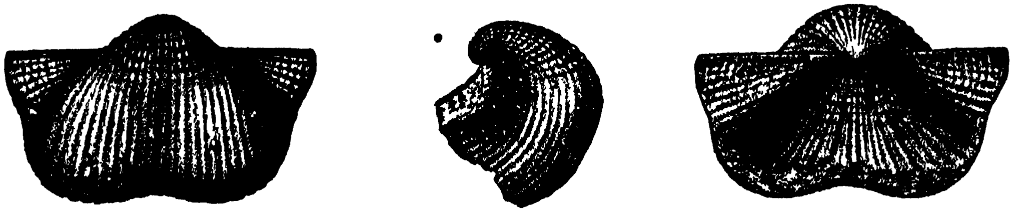

Fig. 22. *Productus semireticulatus*, Mart. Fragmentary specimen from the lowest fossiliferous beds above the lavender-clay of the Chittawán near Ghari: *a.* ventral view; *b.* dorsal view; *c.* lateral view; all natural size.

There is a single very badly preserved specimen in the Salt-range collection that may possibly be united with Martin's species. It is semireticulate in its apical region, and bears on the frontal and lateral parts of the ventral valve about 50 narrow sharp radiating ribs. On these ribs thin erect spines are disseminated; they are chiefly numerous in the depressions by which the wings are marked off from the body of the shell. The median sinus is rather deep and narrow, but the general form of the specimen is a good deal altered by pressure, and thus the general features of the relief cannot be much relied upon.

To give a more accurate description of the specimen seems not advisable, as it is too badly preserved. The subjoined woodcut gives a sufficient clear idea of its features.

Locality and geological position.—I should not have mentioned this specimen, but that its geological position is peculiar, and that it would from this circumstance be of more than common interest. The specimen was collected by myself in the Chittawán near Ghari, in blackish sandstones forming the very lowest fossiliferous beds of the Productus-limestone above the lavender-clays. Thus the species occurs very rarely in the lowest fossilferous beds, and is entirely absent in all the other beds of the Salt-range.

Remarks.—*Prod. semireticulatus* is one of the most characteristic carboniferous species, and is not restricted to a single bed or country, but extends vertically from the lowest beds of the mountain-limestone up to the transition beds between permian and carboniferous, and horizontally it is spread over the whole world. So much the more it is surprising to find so much difficulty in the endeavour to detect the true *Prod. semireticulatus* among the fossils of the Productus-limestone.

It follows from the quotations at the head of the description of this species that I take it in the broadest sense, so that all the forms with numerous narrow radiating ribs fall within its scope. In this sense the specimen here described must receive the name of *Prod. semireticulatus*, Mart.; it is decidedly distinct from all the other 'semireticulate' *Producti* occurring in the Salt-range by its sharp narrow ribs, which amount to the number of 50. It is true this number is not identical with that occurring in typical specimens, but there occur also in Europe varieties having less numerous ribs than the typical form, and which yet cannot be kept separate from the latter. The Indian specimen resembles extremely closely the specimens from Visé, figured by Quenstedt (Petrefactenk. Deutschl., Brach., pl. 58, fig. 38) under the name of *Prod. sulcatus*, but which probably must yet be united with *Prod. semireticulatus* on account of the absence of the thick, lateral, spine-bearing ribs, characteristic of the true *Prod. sulcatus* and *costatus*. Thus it seems to be a well-established fact that the specimen here under consideration on the one hand very closely agrees with *Prod. semireticulatus*, and is on the other hand unique among the forms occurring in the Salt-range.

This sporadic occurrence of this well-known extremely characteristic and widespread carboniferous species just in the lowest fossiliferous beds of the Salt-range is of high geological interest. The species is very common in the carboniferous beds of the Himalaya, and it is highly probable that the great scarcity of *Prod. semireticulatus* in the Salt-range indicates a difference in age of the beds occurring there. We have seen from the description of the fauna up to the present that in the lower division of the Productus-limestone many forms of permian habitus, the *Strophalosiæ*, *Aulosteges*, &c., are mixed with truly carboniferous types like *Reticularia lineata*, &c.; with these occur the *Fusulinæ*, which are entirely restricted to the lower division. All these facts, together with the sporadic occurrence of *Productus semireticulatus*, conduct to the conclusion that the homotaxial position of the lower division of the Productus-limestone of the Salt-range must be about equal to the uppermost beds of the coal-measures of North America.

4. Productus spiralis, Waagen, n. sp., Pl. LXVII, fig. 6; Pl. LXVIII, fig. 3; Pl. LXIX, figs. 1, 2, 3.

It is a rather large species that I distinguish under the above name, the largest species of *Productus* occurring in the Salt-range.

The species is most strikingly characterised by its very strongly inflated and enrolled ventral valve, and chiefly by the large, narrow, spiral wings at the ends of the hingeline.

The ventral valve is very strongly inflated, but of a very equal curve throughout. Longitudinally the curve forms a very regular open spiral, and transversely it forms a high arch, which is somewhat impressed on top, and flattened on both sides towards the wings. The apex is pointed, little prominent, and overhangs the hingeline but very little, though it is so strongly enrolled. The hingeline is straight and always occupies the greatest breadth of the shell. Along the hingeline in some specimens a very distinct and sharply defined area is developed, but strange to say this area is then often provided with thickly strewn, irregularly arranged, short sharp spines. The wings on both ends of the hingeline are very strongly prominent. They are narrow and spirally enrolled. The visceral part of the valve projects far above the wings, and bears a strong sinus in the middle, which commences a short distance from the apex and extends over the trail down to the front margin. The sculpture consists of strong radiating ribs, crossed in the vicinity of the apex by a system of concentric plications, which extend for a distance of 48 mm. to 60 mm. from the apex, measured along the curve. The crossing of these two systems of sculpture causes a very neat reticulation of this part of the shell. The radial costæ are thick and strongly prominent, but on the whole rather regular. They are somewhat thicker in the middle of the valve than on the wings. There are four such costæ in the middle in a space of 10 mm., whilst there are five in the same space on the wings. Some of the radial costæ disappear bye-and-bye in the depth of the median sinus as it becomes narrower and deeper on approaching the frontal margin. On the radial ribs large erect spines are irregularly disseminated. They are more numerous on the wings and along the hingeline than elsewhere. The furrows between the ribs are much narrower than the ribs themselves.

The dorsal valve of the species is only partially known to me, as it is covered in most of the specimens at my disposal by firmly adhering rock-matter. This valve is flatly concave in the visceral portion, bears a strongly prominent median fold towards the front, and is very strongly geniculated where the trail commences. The wings are large and strongly excavated. The hingeline is long and straight, and there often extends along it a narrow but very sharply defined area, which is, however, never provided with spines. The sculpture consists up to the commencement of the trail of a very neat reticulation, which is in every respect the reverse of the reticulation of the other valve. From this sculpture the wings are exempt; they are nearly quite smooth or bear only irregular concentric wrinkles. On the trail or geniculated part of the valve, the sculpture consists only of coarse radial costæ. No erected spines have been observed by me on this valve.

Of the internal characters of this species only those of the dorsal valve are known to me. The cardinal process is extremely short and broad. It is trifid at its upper extremity, and its lateral branches are larger than the median one, which is broad and bears a little groove in the middle. From the process there extend two blunt lateral ridges down to the hingeline. In the middle the process is joined to a broad median elevation, which changes into a narrow, little elevated septum where it extends between the muscular impressions. These latter are large and dendritic situated in rather deep grooves. The two pairs cannot well be distinguished. The brachial ridges are very peculiar. They originate about in the middle of the base of the muscular impressions, then ascend along this base up to the outer corner of it, are then suddenly deflected, descend in the direction of the front and form a large hook. A returning branch towards the middle line of the valve cannot be observed. The whole internal surface of the valve is covered by irregular asperities, but no long thorns seem to exist.

The measurements are approximate, from a specimen with partly preserved "trail" from Swás, as follow :—

Length of the shell in a straight line	71 mm.
„ „ along the curve	150 „
Length of the hingeline	86 „
Thickness of the ventral valve	43 „

Locality and geological position.—This species is the only true *Productus* which occurs somewhat plentifully, in some places even in great numbers, in the lower divisions of the Productus-limestone. It is, however, difficult to extract these large shells in tolerably well preserved specimens from the rock, and thus it happened that not very many specimens of the species are preserved in the Salt-range collection. Specimens of the species were brought by Mr. Wynne from the Verála springs (3 sp.), from Chidru (1 sp.), from Golawáli (2 sp.), from Swás (2 sp.), and trans-Indus from Omarkheyl (7 sp.). I have myself collected the species (3 sp.) in the Chittawán, in the coaly sandstones together with *Spirifer niger*, and at Amb in the so-called *Chonetes*-bed (1 sp.).

Remarks.—The present species is no doubt very nearly related to *Prod. semireticulatus*, Mart., and it is not quite certain whether the shells quoted by Davidson under this latter name from the Salt-range, do not rather belong to *Prod. spiralis* than to Martin's species.

It is however not difficult to distinguish the present form from the true *Prod. semireticulatus*. The most striking distinguishing characters are the much coarser and less numerous radiating ribs, the beautifully spirally enrolled general outline, and the long narrow wings, which form nearly a spirally enrolled tube. All these characters do not occur in *Prod. semireticulatus*, and I have no doubt that they are sufficient to distinguish the present form specifically from Martin's species. To these external characters come yet the internal ones, and if we compare the drawing given by Davidson of the interior of the dorsal valve of *Prod. semireticulatus* with my drawing on Pl. LXIX, fig. 6, there cannot, I think, remain the slightest doubt that the two figures represent two different species. Of the European forms that have been described up to the present, the one figure by Grünewald (Beiträge, pl. III, fig. 1) from Saraninsk most nearly agrees with the shell here under description, only the radial striation is somewhat finer.

Of species occurring in other parts of the world, only the South American *Prod. boliviensis*, Orb., shows a certain similarity to the form here under consideration. It has similarly, long, narrow and spirally enrolled tube-like wings, but it differs from the Indian shell by its very fine radial striation.

5. PRODUCTUS ARATUS, Waagen, n. sp., Pl. LXXII, figs. 1, 2.

The chief characters of this species consist in a more or less transversely rectangular general outline, a very shallow and broad sinus in the middle, and very broad rounded radiating ribs in the frontal part of the ventral valve. The characters of the dorsal valve are not at all known to me.

The ventral valve is strongly curved and inflated, but its curve is rather irregular. The apex is strongly bent in, then comes a somewhat flattened part, which extends as far as the reticulate portion of the valve, and then a blunt geniculation takes place, the remainder of the shell being regularly curved. This is what can be observed of the curve in the longitudinal direction. In the transverse direction the curve is rather regular, only somewhat depressed in the middle. Laterally the valve is somewhat spread out, forming rather large vaulted wings, which are distinctly separated from the remainder of the shell. The apex is pointed, little prominent, and barely at all overhangs the hingeline. This latter is long and marks always the greatest breadth of the shell. Not far from the apex a broad but very shallow sinus commences, which extends down to the front. The sculpture of the valve consists of two systems of plications which are both rather coarse. The concentric plications are restricted to the vicinity of the apex, and extend from there up to a distance of 38 to 43 mm. measured along the curve. The radial plications are of very unequal thickness on different parts of the shell. On the reticulated part, where they are crossed by the concentric folds, they are rather thin, not thicker than these. Lower down, however, mostly two of the plications unite and form one broad rounded fold. These folds extend all parallel to each other down to the front. There are not more than two to three of them within the space of 10mm. On these radial folds there are many large erect spines irregularly disseminated all over the shell; they are not more numerous on the wings, or in the vicinity of the hingeline than elsewhere. There is no rib more strongly developed which would mark off the wings, nor are there more strongly developed or more numerous spines in its place. This indicates clearly that we have to deal here with a form belonging to the group of *Productus semireticulatus.*

Though in all the specimens at my disposal the dorsal valve is preserved, yet I have not succeeded in cleaning it. I can only say that it is strongly geniculated, the visceral part extending not much further than the reticulated part of the ventral valve. All the remainder belongs in both valves to the "trail."

The internal characters of both valves are unknown to me.

The measurements of a specimen are approximately the following :—

Length of the ventral valve in a straight line	14	mm.
" " " " " along the curve	94	"
Length of the hingeline	65	"
Thickness of the ventral valve	34	"

Locality and geological position.—This species is very rare in the Salt-range and has been detected there up to the present only at a single locality and in a single bed. I collected two specimens in the *Cephalopoda*-bed at Jabi (upper Productus-limestone).

Remarks.—The present species is very easily distinguishable from *Prod. semireticulatus*, to which it is most nearly related, by its very coarse parallel radial ribs. From *Productus spiralis*, W., described above, the present species can well be distinguished on a first glance by its very broad shallow sinus and much smaller size. These characters seem to me sufficient to distinguish the form here under consideration as a separate species with a proper name.

d. GROUP OF *PRODUCTUS COSTATUS*, Sow.

6. PRODUCTUS SUBCOSTATUS, Waagen, n. sp., Pl. LXVII, figs. 4, 5; Pl. LXVIII, figs. 1, 2; Pl. LXIX, fig. 4.

This species is always of a moderate size, and never becomes very large. It has a roundish or somewhat transversely oval outline, and the hingeline always occupies the greatest breadth of the shell. The wings are small but distinct, the median sinus is rather deep and not very broad. The sculpture consists of from 25 to 30 rather strong radial ribs, which are all tolerably equal in strength.

The ventral valve is rather strongly inflated and tolerably regular in its curve in the longitudinal direction as well as in the transversal one. The apex is pointed, very little prominent, and barely at all overhangs the hingeline. This latter is straight and always occupies the greatest breadth of the shell. In the majority of specimens it is provided with a narrow but very sharply defined area, which is cut open in the middle by a small deltidial fissure. This area is often provided with an oblique somewhat granular or spiny striation, similar to the striation which has been described above on the area of the dorsal valve of *Aulosteges medlicottianus*, W. On both ends of the hingeline small but distinct vaulted wings are developed, which are separated from the remainder of the shell by a row of spines, situated on a slightly thickened radial rib. At a very short distance from the apex the median sinus commences. In the beginning it is somewhat flattened, but soon it becomes deep and comparatively narrow, and extends in this way down to the front. The sculpture consists of two systems of folds, which are of about equal strength, one concentric, extending to a distance of about 34 to 37 mm. from the apex, measured along the curve, and one radial, the folds of which extend down to the front. The vicinity of the apex becomes thus finely reticulate as in the other allied species. The radial folds are 25 to 30 in number. They are not all of quite equal strength, but tolerably so. There is on each side one slightly more strongly developed rib, marking off the wing from the remainder of the shell. This rib bears always three to four very strong and long spines. The reticulation extends over these spine-bearing ribs as well as over the whole wings. Over the whole surface of the valve very long and strong spines are scattered, always situated on top of longitudinal ribs.

The dorsal valve is very regularly concave with a not very high median fold in the frontal region of the visceral part, extending over the trail down to the shell-margin. The wings are spread out and flatly concave. Also in this valve very often a linear area exists. When this is the case, the apex of the valve is produced, and fills up the deltidial fissure of the other valve. The whole apparatus has, on a small scale, much the appearance of the same parts of ***Aulosteges medlicottianus*, W.**, and suggests the probable existence of a ligament.

The sculpture of the valve consists in a very strong reticulation which extends as far as the visceral part of the valve. On the trail only the radial ribs exist, while on the wings they disappear and only the concentric wrinkles remain. The most singular feature of the valve consists in some three or four deep grooves on each side, situated on the prominent ridges that separate the deeply excavated median part of the valve from the wings; these grooves correspond to the strong spines which are to be found on the other valve, on that slightly more strongly prominent radial rib which occurs at the limit between the wings and the remainder of the shell. The valve bears no traces of any spines.

The interior characters of both valves are unknown to me.

The measurements of a specimen with preserved trail from Khund Ghat are approximately as follow :—

Length of the shell in a straight line	47 mm.
„ „ „ „ along the curve	90 „
„ „ „ „ from the apex to the front margin	35 „
Length of the hingeline	54 „
Thickness of the ventral valve	30 „

This is the largest specimen known to me. The other specimens are mostly somewhat smaller.

Locality and geological position.—This is a rather rare species, and has been found up to the present only in sporadic specimens scattered equally through the middle and upper divisions of the Productus-limestone. In the middle division it has been collected by myself at Káfirkot (2 sp.), and I had found it previously in the upper division at Nanga (1 sp.). Mr. Wynne brought one specimen from the upper division of Khund Ghat, and two specimens from the same division north of Káfirkot.

Remarks.—I for a long time considered the present species as identical with ***Prod. sumatrensis*, F. Roemer**, but after a lengthened and careful consideration of the matter I came to the conclusion that the two must be different, and the Indian shell must receive a new name. It is much to be regretted that the description by Roemer is so very short, and the figures apparently more or less diagramatic, and thus it is rather difficult to decide on questions relating to this species. In treating the matter I have started from the consideration that such an excellent connoisseur of palæozoic fossils as Geheimrath Roemer would most certainly have compared his species with ***Prod. costatus*** and not with ***Prod. semireticulatus***, if in this shell a row of spines were situated on a somewhat prominent radial ridge separating the wings from the remainder of the shell. But as he entirely omits to speak of *Prod. costatus* and compares his shell solely with *Prod. semireticulatus*, it must be taken for granted that there exists no affinity with the first of the two species, and that in reality no such row of spines as has been indicated above nor on the whole a greater number of spines are present. If this be the case Roemer's species cannot be identical with the Indian shell here under consideration. Other points of difference between *Prod. sumatrensis*, Roem. and *Prod.*, *subcostatus*, W., consist in the greater curvature of the ventral valve and the larger and more contorted wings of the latter species, also the age of the two forms seems different. *Productus sumatrensis* occurs together with many *Fusulinæ* and *Schwagerinæ*, whilst *Prod. subcostatus* appears in the first specimens only *above* the *Fusulina* beds.

Next in affinity comes *Productus costatus*, Sow. We must take for comparison the typical form of this species which is represented by Davidson on Pl. XXXII, . 2, 3, 4 of his Mon. Brit. Carb. Brach., or by Koninck in his Monographie du Genre Productus, Pl. X, figs, 3 *a*, *b*, *c*, *d*. This typical form is very easily distinguishable from our Indian shell by the enormously strongly developed radial rib, which separates the wings from the body of the shell, and by the non-extension of the reticulation on the wings. This typical form seems also the predominating one in the mountain-limestone of England and Russia Among many specimens of the species contained in the Hof-Mineralien-Cabinet in Vienna only this typical shape is represented. Together with this typical form, however, in England as well as in Russia other shapes occur, which also have been figured by Davidson and Koninck. As far as my opinion goes, these other forms very probably should be considered for the greater part as hybrids either between *Prod. costatus* and *Prod. muricatus*, Phill., or between the former and *Prod. semireticulatus*, Mart. Howsoever this may be, the Indian shell can be distinguished from these forms by its much robuster form and size and a much larger reticulated part of the shell, which occupies in general 37 mm. in the length, measured along the curve, whilst the same part in the varieties of *Prob. costatus* just mentioned measure only 30 mm.

I thus think myself justified in considering the shell here under consideration as a distinct species, though very nearly related to *Prod. costatus*.

7. PRODUCTUS INDICUS, Waagen, n. sp., Pl. LXX, LXXI, fig. 1.

1862. *Productus costatus*, (Sow.) Davidson : Quart. Journ. Geol. Soc., Lond., Vol. XVIII, p. 31, pl. I, figs. 20-21.

1863. *Productus costatus*, (Sow., Dav.) Koninck : Fossiles paléoz. de l'Inde, page 38, pl. X, figs. 20-21.

The present species is very nearly related to the preceding one. It can be distinguished from the latter by its generally larger size, more irregular ribbing and the absence of the somewhat more prominent rib, which would divide the wings from the remainder of the shell.

The ventral valve is very strongly convex, nearly spirally enrolled. Longitudinally a slightly flattened space can be observed not far from the apex, and also the trail is again somewhat flattened. In the transverse direction the visceral part of the shell appears well elevated above the hingeline, but the curve is regular, only in the middle somewhat impressed. The wings are large, prominent, and vaulted. The hingeline is straight, long, and marks about the greatest breadth of the shell. The apex of the valve is pointed, not much prominent, and overhangs but very little the hingeline. Very near to the apex a strong and deep median sinus commences, and extends down to the front. The sculpture consists of two systems of folds, one concentric and one radial. The concentric folds are very equal in size, and extend partly also over the wings. They cover a space of 43 to 45 mm. from the apex, measured along the curve. The radial ribs are only regular so far as the concentric sculpture extends; further on they become very irregular, some thick, some thin, two and more unite often into one rib, &c. Chiefly in the depth of the sinus several ribs often disappear entirely, and the others converge then towards the front to take up the place of those that have disappeared. Over the whole surface of the valve numerous long erect spines are irregularly distributed. Only four of these spines on each side of the apex have a position in which they are very regularly to be met with. They are situated in the furrow that separates the wing from the remainder of the shell, but are not placed on a radial rib, they seem rather to be in connection with the concentric sculpture.

The dorsal valve is but rarely observable, as it is mostly covered up by rock matter. It is flatly concave in the visceral region and somewhat geniculated where the trail commences. In the middle it bears a little elevated median fold. The wings are flatly spread out and slightly concave. The valve is nicely reticulated on the visceral part. The concentric folds are present on the wings only, and the radial ones only on the trail. On the ridge which separates the wings from the remainder of the valve three or four flat grooves are present, corresponding to strong spines on the other valve.

The interior characters of both valves are well known to me. The inner side of the dorsal valve has been figured already by Mr. Davidson, and I have given on Pl. LXX, figs. 5 and 6, the drawings of two other specimens. The cardinal process is tolerably prominent, and rests on a very broad base. It is distinctly trifid, the median lobe being again sub-divided by a longitudinal groove. The base extends laterally into thickened ridges, which run down to both ends of the hingeline. On the median face of the base a low rounded ridge originates extending to about the middle of the muscular impressions, and then splits into two, leaving open in the middle a deep fissure in which the median septum of the valve originates. This septum extends as far as the visceral part of the valve and suddenly terminates, where the valve begins to become geniculated. The muscular impressions are rather variable in size. They are very large in the specimen represented in fig. 5, and much smaller in the specimen fig. 6. The two pairs of impressions can never well be distinguished. The brachial ridges originate not far from where the median septum commences, pass in a nearly horizontal direction far out towards the lateral margins of the valve, then suddenly turn down, inward and up again, forming thus a very distinct hook. They terminate far away from the median septum, no returning branch being developed. There is a distinctly smoothened and somewhat excavated space in front of the horizontal branch of the brachial ridges, which extends on the one side into the hook-shaped part of these ridges, on the other runs down along the median septum nearly to the end. All the remaining parts of the interior face of the valve are covered with a fine granulation, whilst at the same time a great number of fine pores is disseminated between the granules.

The ventral valve has raised dendritic muscular impressions, not far from the apex, divided from each other by a deep furrow. They belong to the adductors. The divaricators are situated outside and below the former, and are, as usual, larger and striated longitudinally.

The dimensions of the species are rather variable. The largest specimen known up to the present is that figured by Davidson (Quart. Journ., Geol. Soc., Lond., Vol. XVIII., pl. I, fig. 20). Slightly smaller is the specimen figured by me, Pl. LXX, fig. 1. The average size of the specimens occurring in the Salt-range is represented by fig. 2 of the same plate. The measurements of the largest specimen known to me, and of an average-sized specimen, are as follow :—

	I.	II
Length of the shell in a straight line	50 mm.	45 mm.
„ „ „ along the curve	102 „	84 „
Length of the hingeline	61 „	52 „
Thickness of the ventral valve	32 „	30 „

Locality and geological position.—This is the commonest species of the Salt-range. It is, however, restricted to the middle and upper divisions of the Productus-limestone, and is absent in the lower division.

It is preserved in the Salt-range collection from the following localities: From the middle division from Katwáhi (7 sp.), from Khund (11 sp.), from Chidru (8 sp.), from the road between Vurcha and Ucháli (9 sp.), from Khura (2 sp.), from Vurcha (1 sp.), from Virgal (1 sp.), from Musakheyl (5 sp.), from Mora (6 sp.), from the Chittawán (3 sp.), from Kálabágh (10 sp.), from Budikheyl (2 sp.), from Bilot (1 sp.), from Káfirkot (33 sp.), from the Paránga Kuss (1 sp.), and from the Paniála Bluffs at Shekh Budín (6 sp.).

The upper division has furnished specimens at Khund Ghat (17 sp.), at Khura (5 sp.), at Kufri (1 sp.), at Jabi (Cephalopoda-bed 5 sp., lower beds 1 sp.), at Chidru (Cephalopoda-bed 4 sp.).

Remarks.—The present species is very nearly related to the one described before. It can chiefly be distinguished from the latter by its generally larger size and much more irregular radial ribbing, also by the absence of the characteristic radial rib separating the wings from the remainder of the shell.

The form here under consideration has been united by Davidson with *Prod. costatus*, Sow., but in reality it appears less nearly related to that species than to

Prod. subcostatus, W., described before. It can be easily distinguished from Sowerby's species by the constant absence of the thick rib which extends in *Prod. costatus* between the wing and the remainder of the shell. Among hundreds of specimens I have seen, there was not a single one which in this respect would have resembled the typical *Prod. costatus*. This constant dissimilarity in connection with the larger size and less transverse shape of the Indian shells indicates, I think, beyond doubt the existence of a species in India different from *Prod. costatus*. I am even in doubt whether the present species should not, according to its characters, be altogether removed from the group of *Prod. costatus*, and transferred to the group of *Prod. semireticulatus*.

Prod. sumatrensis, F. Roem., which also might be compared, is finer and more regularly ribbed than *Prod. indicus*.

There is yet a circumstance to be mentioned which is perhaps of some interest in connection with this species. Quenstedt in his "Petrefactenkunde Deutschlands, Brachiopoden," draws the attention of men of science to the circumstance that *Prod. semireticulatus*, Mart., is nearly always found with gaping valves, the valves having turned so far on the hinge that the shell became widely open before being imbedded in the rock. Quenstedt considers such a position of the valves impossible if the two had not been united along the hingeline by a ligament. The same position of the valves is the prevailing one in the specimens belonging to the present species as well as to others, and the same suggestion has presented itself to me independently, before I had come on Mr. Quenstedt's observations. Several other points have been adduced already in this work, which tend to make the same supposition at least probable to a certain extent.

8. PRODUCTUS VISHNU, Waagen, n. sp., Pl. LXXI., figs. 2-3.

This is a tolerably large species, with an extremely elevated visceral part, strongly separated wings and an almost entirely smooth frontal part of the ventral valve. The dorsal valve is not known to me.

The ventral valve is extremely inflated, and its curve is very regular, forming nearly an entire spiral in the longitudinal direction. Transversely the shell appears flattened on the wings, then the outline suddenly ascends enormously and forms a highly elevated broad curve, which is strongly impressed in the middle. The apex is pointed, tolerably prominent, and distinctly overhangs the hingeline. Not very far from the apex a very deep and acutely impressed sinus commences, which extends down to the front. The wings are also in certain specimens limited off from the remainder of the shell by a deep furrow, whilst in others this furrow is absent. The sculpture of the valve consists in the apical region in a very coarse reticulation, in which the concentric folds are predominant over the radial ones, and on the wings only the concentric folds are present. This reticulation extends up to 40 mm. distance from the apex measured along the curve. Where the reticulation stops, the radial folds have become already very weak and indistinct, and before they reach the front they disappear almost entirely. The shell has thus in certain positions, when the reticulated part is not visible, a certain resemblance to *Prod. horridus.* Over the whole surface of the valve very strong erect spines are quite irregularly distributed; their number is, however, never very large.

In this species better than in any other species of *Productus* the different structure of the different shell-layers can be observed. The outer layer is quite smooth and compact, covered with a great many fine striæ of growth; the inner layer, on the contrary, is thickly strewn with fine elongated punctures. I have given on Pl. LXXI enlarged figures of both layers.

The dorsal valve as well as the interior characters of the species are entirely unknown to me.

The measurements of a specimen from Chidru are as follow:—

Length of the shell in a straight line	55 mm.
„ „ „ along the curve	107 „
Length of the hingeline	60 „
Thickness of the ventral valve	39 „

Locality and geological position.—This is an extremely rare species, and there have been detected up to the present not more than two specimens of it. Both come from the middle division of the Productus-limestone. One of them was found by Mr. Wynne at Khund, the other by myself at Chidru.

Remarks.—The species which is most nearly related to the one under consideration is *Productus indicus.* I have separated the two specimens on which the present species is founded from *Prod. indicus* on account of the enormously elevated visceral part of the shell and the peculiar sculpture these specimens exhibit.

This is the most peculiar form of all the *Semireticulati,* and it is very strange to observe how it approaches the *Prod. horridus* in its sculpture, yet being so widely separated from that species by its coarsely reticulated apical part. This form might perhaps be considered as the most strongly specialised of all the *Semireticulati.*

c. Group of *PRODUCTUS PORTLOCKIANUS,* Norw. & Pratt.

9. Productus gratiosus, Waagen, n. sp., Pl. LXXII, figs. 3-7.

The dimensions of this species are always very moderate, and specimens as large as the one figured in Pl. LXXII, fig. 3, are great exceptions. As to outline and sculpture, the present species is most elegant, and it reproduces on a small scale, but with much more neatness, the form of *Prod. semireticulatus.*

The ventral valve is rather strongly inflated, but its curve is not very equal in the longitudinal direction. It appears flattened in the apical region as far as the reticulation extends, then a slight geniculation occurs, and only after this does the valve show a regular curve down to the anterior margin. Transversely the curve is regular, strongly impressed in the middle. The apex is strongly pointed, not much bent over, and barely at all overhangs the hingeline. This latter is not very long, but yet occupying the greatest breadth of the shell. In consequence of this the wings are very small, but distinct and pointed. Very near the apex, nearly at its point, a deep rather narrow sinus commences, and extends down to the front line. The sculpture is very characteristic. In the vicinity of the apex a very distinct and fine reticulation exists, which is so very fine and neat that it resembles the very neat reticulation often exhibited on the shell-surface of recent species of *Nassa* or the like. This reticulation extends from the apex, for about 12 mm. measured along the curve. After this only the radial ribs remain; they are very high, and separated from each other by very narrow deep furrows. Sometimes one or the other of the ribs bifurcates; more often, however, the ribs converge from both sides towards the depth of the median sinus, so that often several of them become eliminated towards the anterior border. The ribs are mostly not all of the same strength, those situated on the top of the two lobes or folds produced by the impression of the median sinus being generally thicker and more prominent. On all the radial ribs a great number of very fine erect spines are distributed. They are as numerous as in ***Prod. muricatus***, Phill., but are at the same time so fine that even the place of insertion of the spines can barely be observed, if the surface of the shell is slightly weathered. This is the reason why on the figures Pl. LXXII comparatively so few spines are represented.

The dorsal valve is extremely characteristic in this species. It is on the whole very regularly concave and not geniculated. Its concavity is very strong and interrupted in the middle by a narrow very strongly prominent median fold. The visceral part of the valve is distinctly and very finely reticulated; beyond this only radial ribs remain. These are much narrower and sharper than on the other valve, and are separated from each other by broad rounded furrows. Their distribution is very peculiar: as soon as they pass beyond the reticulated part they diverge fan-like on each side of the median fold, so that the median ones converge towards the top of this fold, while the marginal ones extend towards the wings. A consequence of this distribution is that the ribs very often bifurcate regularly. On the wings themselves only the concentric folds occur. The spines of the other valve are represented on this one by grooves. Erect spines do not exist on the dorsal valve.

The interior characters of this species are not known to me.

The dimensions of the largest specimen are approximately as follow:—

Length of the shell in a straight line	27 mm.
„ „ „ along the curve	55 „
Length of the hingeline	26 „
Thickness of the ventral valve	17 „
Distance of the two valves from each other	12 „

Locality and geological position.—This species is most numerously represented in the middle division of the Productus-limestone. It commences already in the lowest beds of this division, and has been collected in this position by myself at Chidru. The higher beds of the middle division have furnished very numerous specimens at certain localities as at Morahţ where Mr. Wynne collected 25 specimens. I myself found the species in the same geological position west of Katwáhi (1 sp.), at Virgal (coral-beds 1 sp.), on the road from Vurcha to Ucháli (1 sp.), and at Khura, where I observed the species as well in the topmost beds of the middle division (4 sp.), as in the lower beds of the upper division of the Productus-limestone (2 sp.).

The higher beds of the upper division have furnished to me specimens in the *Cephalopoda*-bed at Jabi (7 sp.) and in the same bed at Chidru (1 sp.).

Remarks.—This is one of the most elegant species occurring in the Salt-range. It is no doubt related to a certain extent to *Prod. semireticulatus*, Mart., but the constantly smaller size and the much more prominent radial ribs make a distinction not very difficult. Beyrich figures a variety of *Prod. semireticulatus* from the island of Timor, which most nearly approaches the Indian shell here under consideration; the ribs seem, however, also in this form less elevated. Another European shell to which the present species can be compared is *Prod. griffithianus*, Kon. It has a similarly fine and elegant reticulation in the vicinity of the beak, but it remains always smaller, flatter, and has a geniculated dorsal as well as ventral valve.

I have approached the Indian shell to *Prod. portlockianus*, Norw. and Pratt., on account of the very sharp and deep sinus and the mediocre size exhibited by that American shell, and probably the shell figured by Beyrich from Timor under the name of *Prod. semireticulatus* must also be approached to that species. These three forms, the American and the two eastern ones, seem to constitute a group characteristic of upper-carboniferous and permian beds.

These forms, chiefly the Indian one, seem to be rather nearly related to *Prod. muricatus* of Phillips, on account of the great number of fine erect spines, which are distributed on the radial ribs of the Indian shell. Phillips' species can, however, be distinguished as far as can be judged from the figures, no specimens of the species being available to me, by the absence of a median sinus and of the reticulation in the vicinity of the apex. On account of these characters, however, the true *Prod. muricatus* seems to be referable to a quite different division of the genus, and the transitional forms between that species and *Prod. costatus*, Sow., that have been observed by Mr. Davidson must be attributed very likely only to hybridity.

III.—Section SPINOSI.

f. Group of *PRODUCTUS MURICATUS*, Phillips.

10. Productus asperulus, Waagen, n. sp., Pl. LXXIX, figs. 3-6.

The general outline of this species is roundish or transversely oval. The shell is always of a very moderate size; the ventral valve never inflated, and the dorsal one only flatly concave. Both valves are covered with a comparatively coarse radial ribbing, on which very numerous erect spines are placed.

The ventral valve is flat, never much vaulted. Its curve is rather regular in the longitudinal direction, only the apex being slightly more strongly bent. In the transverse direction the curve is yet more regular, only in the middle a slight depression takes place in some specimens. The hingeline is short, always shorter than the greatest breadth of the shell. The apex is pointed, but little bent over, barely prominent, and not at all overhanging the hingeline. At a certain distance from the apex in some specimens a slight median depression is developed, which extends down to the front. The sculpture of the valve consists in a coarse radial striation or ribbing, which is rather irregular, inasmuch as the ribs are often dichotomous towards the front or else sometimes also two are united into one. On these ribs very numerous erect spines are irregularly distributed. Generally a spine is developed where a rib splits up in two, but also otherwise the ribs are provided with spines. The ribs are generally slightly swollen where a spine rests on them. Also along the hingeline a very distinct row of spines extends.

The dorsal valve is flatly concave, with little developed flattened wings, on which only a slight concentric folding is observable. The sculpture of the valve consists of coarse dichotomous radiating striæ, on which sometimes slight traces of spines can be observed. Between the ribs at some places deep grooves are to be found, which correspond to some of the erect spines of the other valve. The ribs of this valve are very distinctly flattened on the top.

Of the interior characters of this species nothing but the cardinal process is known to me, which is rather small and trifid, supported by two lateral ridges and a median septum. This latter becomes bifid not far from the cardinal process.

The measurements of a specimen from Jabi are approximately the following :—

Length of the shell in a straight line	27 mm.
„ „ „ along the curve	39 „
Greatest breadth of the shell	32 „
Length of the hingeline	22 „
Thickness of the ventral valve	11 „
Distance of the two valves from each other	6 „

Locality and geological position.—The species is on the whole rather rare in the Salt-range. It has been chiefly found by me in the *Cephalopoda*-bed of the upper Productus-limestone at Jabi, where I obtained six specimens. It is much less frequent in the *Cephalopoda*-bed at Chidru, only two tolerably well presceved specimens having been collected by me.

The species is, however, not restricted to the upper division only, two fragments of the species having also been found by me in the middle division at Káfirkot.

Remarks.—The shells under consideration have puzzled me a great deal, as it appeared very difficult to decide in what relations to other forms these specimens might stand. On a first glance the species is not dissimilar to ***Prod. cora***, Orb., but the radial ribs are much coarser, the spines much more numerous, and the concentric folds on the wings are absent. Also *Prod. carbonarius*, Kon., or *Prod. koninckianus*, Keys, as well as *Prod. canorini*, Keys, all three forming one group, are similar to a certain extent to these shells; and I was long time in doubt whether I should not consider *Prod. asperulus* as forming part of this group of forms. Nevertheless I could not satisfy myself in this direction. In those species the radial ribbing is much finer and the spines cause an elongated swelling of the ribs, which is not observable in the Indian shells. Thus it appeared impossible to affiliate this form to the species mentioned above, and there remained at last only *Productus muricatus*, Phill., to which the new species could be compared.

Phillips' species was but very imperfectly and inaccurately known before the publication of Mr. Davidson's admirable drawings of it, but from these drawings it appears that *Prod. muricatus* does not belong to the *Semireticulati*, but rather to the "*Spinosi*," as there seems to be no trace of a reticulation in the vicinity of the apex. In the specimen figured by Davidson (Mon. Brit. Carb. Brach., pl. XXXII, fig. 13) the radial ribs are as fine as in the Indian specimens, and in the magnified figure the ribbing shows absolutely the same irregularities which appear in my specimens. Also the character of the spines is identical in both. I thus came to consider the *Prod. asperulus* as very nearly related to *Prod. muricatus*, and distinct from Phillips' species chiefly only by its comparatively flat ventral valve and little projecting visceral region.

IV.—SECTION: FIMBRIATI.

g.—GROUP OF *PRODUCTUS HUMBOLDTI*, Orb.

2. PRODUCTUS HUMBOLDTI, Orbigny, Pl. LXXVI. figs. 1-3.

1842. *Productus humboldti*, Orbigny: Voyage dans l'Amérique Méridionale, Tome III, 4me Partie, p. 54, Pl. V, figs. 4-7.
1846. *Productus humboldti*, (Orb.) Keyserling: Petshoraland, p. 201, Pl. IV, fig. 3.
1847. *Productus humboldti*, (Orb) Koninck: Monogr. d. gen. Prod. et Chon. p. 114, Pl. XII, fig. 2 a, b, c.
1862. *Productus humboldti*, (Orb.) Möller: Mining Journal of St. Petersburg, p.?
1878. *Productus humboldti*, (Orb.) Abich: Bergkalk-Fauna von Djoulfa, p. 35, Pl. V, fig. 2.
1879. *Strophalosia horrescens*, (Vern.) Möller: Neu. Jahrb. f. Min., p. 233-234.

The species is generally of a moderate size, and only rarely are specimens met with exhibiting the size of D'Orbigny's original.

The general outline is always more or less transversely oval, and the ventral valve, which is generally not very strongly inflated, bears in the middle a sinus of somewhat variable depth. The whole surface is covered with a great number of fine bent-up spines.

The ventral valve is mostly only moderately inflated, sometimes even rather flat. Its curve is tolerably regular in both directions. The apex is thin, pointed, not much prominent, and strongly bent over. It overhangs slightly the hingeline. This latter is straight, always shorter than the greatest breadth of the shell, and in nearly all the specimens at my disposal provided with a narrow area. At both ends of the hingeline small rounded wings are developed, in which the hingeline joins the lateral margins of the valve under an obtuse angle. Not far from the apex a mostly rather shallow sinus commences, which extends often not quite down to the anterior margin. The whole surface is covered with very numerous small elongated tubercles, which at their lower extremity bear a thin erect spine. These tubercles are much finer and more numerous in the vicinity of the anterior and lateral margins of the valve, and this more finely tuberculated space forms a distinct zone all round these margins. This finely taberculated zone is a peculiarity characteristic of all the species belonging to the group of *Productus humboldti*. The tubercles are arranged irregularly in quincunx.

The dorsal valve is very flat, barely at all concave. In the vicinity of the apex two diverging folds exist, which separate the wings from the visceral part of the valve. A median fold, corresponding to the sinus of the other valve, can barely be distinguished. The sculpture of the valve consists of very numerous little grooves arranged in quincunx, between which very fine little spines are distributed.

The interior characters of the species are not known to me.

The measurements of a specimen from Vurcha are approximately the following:—

Length of the shell in a straight line	30 mm.
„ „ „ along the curve	50 „
Greatest breadth of the shell	35 „
Length of the hingeline	24 „
Thickness of the ventral valve	15 „
Distance of the two valves from each other	12 „

Locality and geological position.—*Productus humboldti* is very rare in the Salt-range; there have been found up to the present only five specimens, which all come from the middle division of the Productus-limestone. There have been collected two specimens by myself in the section at Khura in the upper region of the middle division, and two other specimens in a somewhat lower position at Káfir-kot. Mr. Wynne brought one specimen from the middle division at Vurcha.

Remarks.—I regret very much to say that I must differ somewhat from Mr. Davidson in the interpretation of this species. The shell that has been figured by him from the Salt-range under the name of *Productus humboldti* seems to differ from the true form of the species that has been so excellently figured by Koninck, by its much coarser sculpture and less numerous tubercles, and agrees in this respect much more with the shell that has been described by Abich from Djoulfa under the name of *Prod. scabriculus.* There seems therefore to me a distinction necessary, and I therefore shall describe this coarsely tuberculated shell under the name of *Prod. abichi.*

I thus retain the name of *Productus humboldti* only for the finely tuberculated shells which are very rare in the Salt-range, but which seem to be characteristic of the beds of the coal-measures of South America and of the upper carboniferous limestone of the Ural. The forms approach in all respects very nearly the shell that has been figured by Koninck from Yarbichambi, and the chief difference seems only to consist in a somewhat more elevated visceral part of the American shell. I shall, however, have occasion to demonstrate on the specimens belonging to the species *Prod. abichi* that this character is rather variable and that specimens with and without a moderately elevated visceral part occur in the same species.

The Indian specimens of *Prod. humboldti* are absolutely identical with what has been described by Abich from Djoulfa as belonging to the same species. Also at Djoulfa this species is apparently rare, as Geheimrath Abich possesses only a single specimen from there.

The bed in which this shell was found has been identified by Möller as of permian age, and this has probably also been the reason why Prof. Möller considered Abich's specimen as belonging to *Strophalosia horrescens*, Vern., otherwise I cannot quite well conceive why this should have been done. Abich's specimen has neither a trace of a point of attachment on the ventral valve, nor the trace of an area, and thus it is impossible to consider it as anything else than a *Productus*.

The occurrence of *Prod. humboldti* in the permian beds of Djoulfa is of very great interest, as it shows that the species ascends in single specimens up into the permian formation.

12. Productus abichi, Waagen, n. sp., Pl. LXXIV, figs. 1-7.

1862. *Productus humboldti*, (Orb.) Davidson: Quart. Journ. Geol. Soc. Lond., Vol. XVIII, p. 32, pl. II, fig. 6.

1863. *Productus humboldti*, (Orb., Davids.) Koninck: Foss. paléoz, de l'Inde, p. 39, pl. XII, fig. 6.

1878. *Productus scabriculus*, (Mart.) Abich: Geologische Forschungen in den kaukasischen Ländern, Vol. I, Ueber eine Bergkalk-Fauna von Djoulfa, p. 33, pl. V, fig. 3.

1879. *Strophalosia horrescens*, (Vern.) Möller: Neues Jahrb. f. Min. p. 233-234.

This species is much more common than the preceding one. It has the same transversely oval outline, a moderately inflated ventral valve with a flat sinus in the middle, but the sculpture is different. It consists of rather coarse, very strongly elongated and more or less irregularly arranged tubercles, which bear at their anterior extremity thin somewhat erect spines. The number of these tubercles is much smaller than in the true *Prod. humboldti*.

The ventral valve is not very strongly inflated generally, and only some rare specimens, as the one figured Pl. LXXIV, fig. 7, make an exception to this rule. The curve is generally very regular in the longitudinal direction, less so transversely. In this latter direction the sides appear to ascend rather abruptly, while the valve is rather flattened on top with a median impression for the sinus. The wings are small and barely flattened. The frontline is always impressed as the median sinus of the valve extends down to it; the lateral margins are well rounded and join the hingeline always under an obtuse angle. This latter is straight and always shorter than the greatest breadth of the shell. Mostly there extends a small area along the hingeline which in some cases attains a breadth of one millimeter, it is then cut out in the middle by a very large sharply defined deltidial fissure. The apex is very strongly bent over, thin, pointed and only very slightly overhanging the hingeline. The median sinus commences in some specimens immediately at the apex, in others only at a certain distance from it. This sinus is mostly rather deep and well developed, and extends down to the frontline. The most characteristic feature of the valve is its sculpture. This is not everywhere and in all specimens absolutely the same. On the greater part of the valve it consists of rather strong elongated tubercles, which are mostly arranged in a rather regular quincunx and bear at their anterior extremity a rather long thin spine, which is but little elevated over the surface of the valve and directed forward. On the wings and towards the lateral and frontal margins the tubercles become much smaller, much more closely packed together, and are no longer elongated but forming roundish pustules. These bear erect spines on the top and are arranged in concentric zones, which are separated from each other by strong imbricating striæ of growth. Otherwise a concentric sculpture is entirely absent in the specimens belonging to this species.

The dorsal valve is nearly quite flat, and only the margins are somewhat bent up. The apex is distinctly excavated, and on both sides of it originate low, broad, diverging folds, which separate the flattened wings from the visceral part of the valve. At a very short distance from the excavated apex a broad, low, median fold is developed extending to the frontal margin. The hingeline is generally without an area in this valve. The sculpture of the valve is very characteristic. It consists of a great number of low rounded little pits, which are arranged very regularly in quincunx, and between these pits an equal number of very fine erect spines are placed.

The interior characters of the species are well known to me. In the ventral valve the lower margin of the area is always thickly set with a row of fine short spines, comb-like. The shell is always extremely thin and fragile, and thus the attachments of the muscles are but very little impressed and rather indistinct. The adductors form two elongated impressions on both sides of the middle line not far from the apex, but I cannot distinguish a dendritic sculpture on them. The divaricators are much larger, extending a good deal further down than the adductors, and are radially striated. They are situated outside and below the adductors. The whole inside of the valve is covered with alternating grooves, corresponding to the tubercles of the outer side, but there are no open pores in which the hollow spines would terminate. A more or less broad zone along the margins of the valve is thickly covered by small spiny tubercles.

In the dorsal valve the cardinal process is very long and thin, trifid at its upper extremity. At its base it bears two prominent tubercles. Laterally it is supported by two stout ridges, which extend interiorly along the hinge-margin, and on its lower side it is prolonged into a long, thin, high, blade-like median septum. On both sides of the septum, about in the middle of the valve, two prominent elongated tubercles are situated, above which the muscular impressions are placed; these are dendritic. The two pairs of adductors can barely be distinguished. The same is the case with the brachial ridges, which are so faint that it is barely possible to see them. I cannot positively assert that they have been rightly represented by the draftsman; their size is, however, correct in the drawing. At the place where the shell begins to be bent up, and lower down, are situated a great number of long thin thorns, directed forward. Otherwise the whole internal surface of the valve is covered with a not very fine granulation.

There are some specimens in the Salt-range collection which I suppose to have preserved their original colour. While all the other specimens in the same beds are of a greyish yellow, these are of a dark violet or reddish brown. I have attempted to represent these colours on the plate.

The measurements of the specimens belonging to this species are rather uniform. The largest specimen known to me, from the *Cephalopoda*-bed at Jabi, exhibits the following dimensions:—

Length of the shell in a straight line	34 mm.
„ „ „ dorsal valve in a stright line	27 „
„ „ „ ventral valve along the curve	65 „
Greatest breadth of the shell	42 „
Length of the hingeline	32 „
Thickness of the ventral valve	21 „
Distance of the two valves from each other	17 „

Locality and geological position.—The species is rather common in the Productus-limestone of the Salt-range. It occurs there in the middle division as well as in the upper division, but has not been detected up to the present in the lower division.

In the middle division it has been found at Khund (1 sp.), in the section at Khura (2 sp.), at Morah (10 sp.), on the road between Vurcha and Uchâli (7 sp.), at Musakheyl (2 sp.), at Chidru (4 sp.), and at Káfirkot (10 sp).

Out of the upper division it came from the following localities: From the section at Khura (1 sp.), and west of the same village (6 sp.), from the *Cephalopoda*-bed at Jabi (11 sp.), and from the same bed at Chidru (7 sp.).

Remarks.—The present species has been long known to science, but either it has been united with *Prod. humboldti*, or it has otherwise been wrongly identified. It must be admitted that it can scarcely be considered as directly wrong that one should consider the shells here under consideration to form one and the same species with *Productus humboldti*, as it is solely a matter of taste whether the differences be admitted or not as sufficient for the distinction of two separate species. To me it appeared more practical to distinguish the frequent form of the Salt-range, which deviates by its coarser tuberculation and by the more elongated form of the tubercles from the true *Prod. humboldti*, under a separate name, in order to let it immediately appear most distinctly that forms exactly agreeing with the true *Prod. humboldti* are very rare, while that species is for the most part replaced here by another form, which, though not very different, yet can always be distinguished from the typical shape.

By Geheimrath Abich this species has been identified with *Prod. scabriculus*, Mart., but it is distinct from Martin's species by the absence of any radial striation to support the tubercles.

Prof. Möller's identification of the present species with *Strophalosia horrescens*, Vern. is quite as wrong. It cannot be denied that the whole group of *Prod. humboldti* bears a certain resemblance to that *Strophalosia*, but even if in some exceptional specimens the area is comparatively not so very small, yet there is never observable a point of attachment on the ventral valve, nor are there any traces of hingeteeth developed. Also in Abich's specimen from Armenia the area does not exceed the height of one millimeter, dimensions which very often occur in true species of *Productus*. Otherwise the specimens from the Salt-range and that from Armenia are extremely similar, only the arrangement of the tubercles is not so regularly in quincunx in Abich's specimen as in the greater number of specimens from the Salt-range, but there are also in the latter place specimens which have their tubercles quite as irregularly arranged. I think there can be no doubt about the Salt-range form being absolutely identical with that from the permian beds of Armenia.

Of other species *Prod. nebrascensis*, Owen, must still be compared. This species also has been mistaken by Geinitz for *Stroph. horrescens*—a further proof how similar the whole group of *Prod. humboldti* is to that permian species. *Prod. nebrascensis* is very easily distinguishable from *Prod. abichi* by the two different sets of spines it possesses, and by the more distinct radial striation, interrupted from distance to distance by concentric folds.

13. PRODUCTUS SERIALIS, Waagen, n. sp., Pl. LXXIV, fig. 8; Pl. LXXV, figs. 1, 2.

It is with much doubt that I introduce this species; it cannot however be denied that the specimens which I describe under the name show certain peculiarities by which they deviate from other forms.

The shells are on the whole very similar to *Prod. abichi*, but distinct by a well-developed concentric folding, in a more or less close relation to the spines distributed on the surface of the ventral valve. It is even not improbable that I include two species under this name, each represented by a single specimen, of which the one bears very coarse, the other very fine spines. The materials are, however, not sufficient to make the distinction complete.

In both specimens the ventral valve is not very strongly vaulted, and its curve is tolerably equal in both directions. The apex is pointed, not very prominent, well bent over and barely overhanging the hingeline. This latter is always considerably shorter than the greatest breadth of the shell, and in one of the specimens (Pl. LXXIV, fig. 8) is provided with an area of one millimeter in breadth. The wings are small and barely flattened. The valve possesses a rather deep median sinus, which commences at the apex itself in the specimen figured Pl. LXXIV, fig. 8, while in the other specimen its commencement is at a certain distance from the apex. The sculpture is different in the two specimens. In the one (Pl. LXXIV, fig. 8) it consists of strong very much elongated tubercles bearing at their extremities spines which are directed forward; between these, smaller tubercles are irregularly distributed having erect spines. In the other specimen (Pl. LXXV, fig. 2) the elongated tubercles are much thinner, and the smaller ones with erect spines much less frequent. In both specimens the tubercles become smaller and more numerous towards the margin. Between these tubercles in both specimens eight strong concentric folds extend, on the margins of which the greater numbers of the spines are situated.

The dorsal valve is nearly quite flat, and only the margins are somewhat bent up. It bears a sculpture which is coarse in the one and fine in the other specimen, but otherwise the characters of the sculpture are very similar. It consists of very numerous little grooves, between which a great number of fine, more or less erect, spines are situated. There is moreover no very distinct concentric folding of the valve observable.

The interior of a dorsal valve, which I suppose to belong to this species, is figured in Pl. LXXV, fig. 1. The cardinal process is very large in this valve and deeply trifid. It bears a rounded boss at its base and is laterally supported by two very strong and high horizontal ridges, which extend for the whole length of the hingeline. Towards the interior of the valve the cardinal process is continued into a high blade-like median septum, which extends as far as the visceral part of the valve. On both sides of the septum, not far from the base of the cardinal process, the muscular impressions are very distinctly visible. They are comparatively small, dendritic, and the two pairs can well be distinguished. The brachial ridges are well developed, and are composed of an obliquely descending lamella which suddenly bends round forming a hook-shaped curve extending down to the very edge of the visceral part of the valve. This latter is very distinctly marked off from the trail by an angular ridge which is thickly set with long strong spines. Also the trail is covered by many spiny tubercles, while on the remainder of the interior surface of the valve only a fine granulation is observable.

Of the interior of the ventral valve nothing is known to me.

One of the specimens in my possession shows the same colour as those specimens of *Prod. abichi*, and which I supposed in them to be the original colouring.

The dimensions of the two specimens, both from Jabi, are as follow :—

	I.	II.
Length of the shell in a straight line	33 mm.	29 mm.
„ „ along the curve	60 „	50 „
Length of the dorsal valve	29 „	26 „
Greatest breadth of the shell	41 „	35 „
Length of the hingeline	30 „	26 „
Thickness of the ventral valve	19 „	15 „
Distance of the two valves from each other	15 „	12 „

Locality and geological position.—There have altogether been detected up to the present only the three specimens that have been figured. All three were collected by myself at Jabi in the *Cephalopda*-bed of the upper division of the Productus-limestone.

Remarks.—The present species can on a first glance only with difficulty be distinguished from *Productus abichi,* from which it differs by its concentric sculpture.

Another species, to which the present one is very nearly related, is *Prod. nebrascensis,* Owen. Specimens of the species that I have obtained from Illinois are however much less transversely oval, the hingeline is comparatively long, and the sculpture is quite different. The spines, as has been rightly observed by Meek, consist of two different kinds, which are approximately alternating. The thicker ones are erect, the thinner ones bent forward at a short distance from the surface of the valve. Besides this the spines are situated on a kind of radial striation, not dissimilar to that existing in *Prod. scabriculus,* Mart. These characters of the sculpture do not at all agree with those of our Indian shells, in which erect spines occur only exceptionally, and a radial striation is entirely absent. Only the concentric folds are common to both species.

14. PRODUCTUS CYLINDRICUS, Waagen, n. sp., Pl. LXXV, figs. 3. 4.

The specimens composing this species attain not quite middle size. They are characterised by vertical sides, parallel lateral margins and a very much produced anterior part of the shell, whereby the general outline becomes nearly rectangular. The sculpture consists of a rather fine granulation, which changes into a radial striation on the produced part.

The ventral valve is very strongly but rather irregularly vaulted. In the longitudinal direction the spiral part appears very strongly curved, whilst the anterior part is considerably flattened. In the transverse direction the outline ascends vertically from the lateral margin, and forms a flattened curve, which is somewhat impressed in the middle, on the median part of the valve. The apex is attenuated, pointed, strongly bent over and not much prominent; it barely overhangs the hingeline. This latter is short, equal to or shorter than the greatest breadth of the shell. In none of the few specimens at my disposal is it provided with an area. There are no wings at the ends of the hingeline. The valve is provided with a not very deep median sinus which commences at a short distance from the apex, and disappears again before it has quite reached the anterior margin of the valve, which, in consequence, has a rounded, not indented, outline. The sculpture of the valve is of two different kinds. On the visceral part of the valve, up to a distance of about 35 mm. from the apex, measured along the curve, the sculpture consists of numerous, fine, elongated, sharply-pointed tubercles, which are arranged irregularly in quincunx, and are placed on some coarse, not strongly developed concentric folds. The tubercles have evidently once served for the support of spines, but these are not preserved on any of the specimens at my disposal. When the shell grows larger, tubercles and spines disappear altogether, and are replaced by a fine radial striation which becomes more and more coarse as it approaches the interior margin, so that this margin at last is ornamented only by a few coarse folds.

The dorsal valve is flat in the visceral region, with bent-up margins. The apex is most strongly excavated, and from both sides of it there extend two low strongly diverging folds towards the lateral margins of the valve. At a certain distance from the apex a low broad median fold is developed, which disappears again further on. The sculpture consists of a great number of little grooves, arranged about in quincunx, between which very numerous, extremely fine, hair-like erect spines are placed.

The interior characters of the species are not known to me.

The dimensions of a rather small but very complete specimen from Chidru are as follow :—

Length of the shell in a straight line	33 mm.
„ „ „ along the curve	62 „
„ „ dorsal valve	22 „
Greatest breadth of the shell	26 „
Length of the hingeline	21 „
Thickness of the ventral valve	19 „
Distance of the two valves from each other	15 „

Large specimens are about 37 mm. in length and 29 mm. in breadth, but these are the largest known to me.

Locality and geological position.—This is a very rare species, and has been found by me only in the *Cephalopoda*-bed of the upper Productus-limestone. I collected the species in this bed both at Jabi (4 specimens) and at Chidru (1 sp). Another specimen has been found by Mr. Wynne at Vurcha, but the bed it came from is not known.

Remarks.—The form most nearly related to the present species is beyond doubt *Productus humboldti*, Orb. It has the same fine granulation, but there are wings developed, the general outline is not rectangular, the sides not vertical, and on the margin of the ventral valve, which is anteriorly not produced, there is a granulation instead of a radial striation, so that *Productus humboldti* can most easily be distinguished, and the present form must be separated from it under a different name.

Productus cylindricus bears, however, yet a great resemblance to other shells which have mostly been described under the name of *Strophalosia horrescens*, Vern., var. *elongata*, Barbot de Marny, or var. *prysmatica*, Golovkinsky. It is true that these shells have a well distinguishable area, but as we know that an area occurs also not very rarely in species of *Productus*, it would be highly desirable to learn some more particulars about the internal structure of these shells, in order to make sure whether they ought to be considered really as a *Strophalosia* or else as a *Productus*. If the latter be the case, the possibility would not be excluded that these shells were identical with our *Productus cylindricus*.

h.—? GROUP OF *PRODUCTUS PUSTULOSUS*, Phill.

15. PRODUCTUS BHALENSIS, Waagen, n. sp., Pl. LXXV, fig. 5.

It is only upon a single specimen that I can found this species, but the occurrence of this specimen in the *Fusulina*-sandstone of Bhal is of too great interest to pass it over in silence.

The general outline is somewhat triangular, the hingeline being very short and the front comparatively very broad. The ventral valve is not very much vaulted, but the curve is very regular in both directions. The apex is rounded, not pointed, barely at all prominent and little incurved. It is not quite regularly developed but somewhat twisted to one side. The hingeline is not quite straight, but at both ends a little bent up. An area seems not to exist. The wings are very small but flattened, and their outline forms an obtuse angle. The valve presents in the middle a kind of flattening or very shallow median sinus, which commences at a short distance from the apex and extends down to the front. On the specimen which I have for description the shell is only partly preserved, the greater part of it being an internal cast only. The substance of the shell is, however, so very thin that the sculpture of the cast is identical with that of the shell. This sculpture consists in numerous, slightly elongated tubercles, which apparently have borne very thin spines. The tubercles are arranged irregularly in quincunx, and the whole surface is sub-divided in broad concentric zones by a few concentric folds extending parallel to the shell margins.

Neither the dorsal valve nor the interior characters of the species are known to me.

The measurements of the only existing specimen are as follow :—

Length of the shell in a straight line	18 mm
„ „ „ along the curve	75 „
Greatest breadth of the shell	50 „
Length of the hingeline	22 „
Thickness of the ventral valve	26 „

Locality and geological position.—The only specimen of this species that has been detected up to the present was found by myself at Bhal in the lower division of the Productus-limestone, contained in a greyish-yellow sandstone filled with numerous beautifully preserved specimens of *Fusulinæ.*

Remarks.—It is with very great doubt that I introduce this species. If it is really a *Productus*, it is most certainly different from all the forms hitherto described. It must then be placed in the vicinity of *Productus pustulosus*, Phill., on account of the character and distribution of its tubercles, but is easily distinguishable from that species by its triangular shape and extremely short hingeline. I must, however, doubt to a certain extent whether this shell is in reality a *Productus*. The bending and twisting of its apex to one side gives a certain irregularity to the form, which recalls somewhat the shape of *Strophalosia*, though I cannot detect a place of attachment nor an area in the ventral valve. But if this shell be really a *Strophalosia*, a question which can only be solved when more extensive materials will be procurable, then it is apparently very nearly related to *Strop. horrescens*, Vern., and might even prove identical with that species.

i.—*ISOLATED SPECIES.*

16. PRODUCTUS PURDONI, Davidson, Pl. LXXIII, figs. 1-3.

1862. *Productus purdoni*, Davidson: Quart. Jour. Geol. Soc. Lond., Vol. XVIII, p. 31, pl. II, fig. 5.
1863. *Productus purdoni* (Dav.) Koninck: Foss. paléoz. de l'Inde, p. 38, pl. XII, fig. 5.

This is one of the most beautiful species of the Salt-range, but at the same time rather rare.

It is well characterised by the little-inflated ventral valve, its extremely short hingeline, and its sculpture, which consists of extremely numerous fine spines. The general outline is nearly always longer than broad, only in young specimens the reverse is sometimes the case, and the greatest breadth of the shell is always situated in the lower third on its length. The margins are always well rounded, and the front-line is mostly, but not always, indented.

The ventral valve is moderately inflated, but its curve is not regular. In the longitudinal direction the apex is strongly bent and even rolled in, but soon the curve becomes less strong and towards the front the valve appears considerably flattened. In the transverse direction the lateral parts of the valve ascend tolerably strongly, then the shell suddenly bends round to the flattened and slightly impressed middle part. The apex is pointed, very little prominent, not at all overhanging the hingeline. This latter is very short, and in most specimens not quite straight but arched. At both ends it projects a little and causes the formation of very small slightly flattened wings. At a more or less small distance from the apex a median sinus commences which is always broad and often very deep; it extends in all the specimens, with a single exception, to the front of the valve. The sculpture consists of numerous fine elongated tubercles, which are finer and more numerous towards the margins than on the visceral part of the valve. They are mostly arranged very regularly in quincunx, so that the shell appears as if covered with a cross-lineation. The tubercles have served for the support of very thin hair-like tubular spines, which are, however, only very rarely preserved. If the shell is somewhat deteriorated by weathering, chiefly in the vicinity of the margins or on the small wings, the holes which pierce the tubercles are enlarged, and then the shell surface resembles exactly that of *Eichwaldia*, a very fine reticulation being produced. There are on the visceral part of the valve about 6 tubercles within the space of 5 mm., but on the margins I count not less than 10 tubercles within the same space. In one specimen an indistinct radial plication is added to this tuberculation, commencing about midway of the valve and extending down to the margins, the different folds being of very unequal strength.

The dorsal valve is rather flat with a slightly vaulted apical region, which is separated from the wings by two diverging furrows. From this slightly raised apical region a strong and broad median fold takes its origin, and reaches down to the front. On both sides of this fold two excavated roundish parts of the valve are situated. The margins of the valve are more or less strongly bent up, giving to the whole valve a concave appearance. The sculpture consists of a great number of small shallow grooves arranged in quincunx, between which a yet finer granulation is observable, the bases of very fine hair-like spines.

The interior characters of the species are not known to me, except that a comparatively small cardinal process and a very long and strong median septum has been observed in the dorsal valve.

The dimensions of a rather large specimen from Chidru are as follow :—

Length of the shell in a straight line	73 mm.
„ „ „ along the curve	114 „
„ „ „ dorsal valve	62 „
Greatest breadth of the shell	60 „
Length of the hingeline	35 „
Thickness of the ventral valve	31 „
Distance of the two valves from each other	30 „

Locality and geological position.—The species is not very common in the Salt-range, and occurs chiefly in the upper division of the Productus-limestone.

The geologically oldest specimen was found by Mr. Wynne at Kálabágh in grey limestone together with several other fossils which indicate that the bed from which this specimen came was on the limit between the middle and upper divisions of the Productus-limestone.

In the upper division the species has been found by me in the section at Khura (1 sp.), in the section near Kufri (1 sp.), and at Chidru (4 sp.); Dr. Oldham found it at Musakheyl (not silicified, but in a yellowish-grey sandstone, characteristic of the upper division (1 sp.), and Mr. Wynne found the species trans-Indus at Bilot.

The geologically youngest specimen I found myself at Virgal (bed No. I of the section) in the grey sandstones forming the topmost bed of the upper division of the Productus-limestone, immediately below the Ceratite beds. This is the only species of *Productus* that has been found in these sandstones.

Remarks.—The present species is very peculiar in its sculpture and shape, and though to a certain extent it recalls the forms more or less allied to *Productus humboldti*, yet I should not like to directly affiliate it to that group of forms. The hingeline is much shorter and mostly arched, the general outline much more elongated, and the form and arrangement of the tubercles is so peculiar that I must consider the species here under consideration as an isolated form, the relations of which cannot exactly be made out for the present.

The species has not yet been detected in any other part of the world, except in the Himalaya at the Niti Pass, whence it has been described by Salter. The occurrence of this species at that locality indicates with great probability the existence there of beds of the age of the upper division of the Productus-limestone of the Salt-range, while generally the carboniferous beds of the Himalaya appear to be geologically older.

V.—SECTION : HORRIDI.

k.—GROUP OF *PRODUCTUS GEINITZIANUS*, Kon.

17. PRODUCTUS OPUNTIA, Waagen, n. sp., Pl. LXXIX, figs. 1—2.

This species shows always very small dimensions, and resembles in this respect *Productus spinulosus*, Sow. Its general outline is somewhat squarish, the wings very small, the apical part extremely strongly elevated, and the surface covered with many little spines.

The ventral valve is very strongly inflated, and its curve is very regular in both directions. The apex is well pointed, strongly enrolled, in its median part very highly elevated over the hingeline and strongly overhanging it. The hingeline is comparatively long and always occupies the greatest breadth of the shell. At both ends of it small rectangular wings are developed which are but little flattened. A median sinus is never present, only in some specimens a slight flattening of the median part of the valve can be observed. The surface sculpture consists of not very closely set, roundish, pointed tubercles, which are approximately arranged in quincunx. I do not know whether these tubercles have served for the support of spines or not, as in none of the specimens at hand are spines preserved. These tubercles are sometimes in connection with longitudinal ribs, on which they are placed. The latter are chiefly distinct towards the margins of the valve, whilst the tubercles are all of about equal strength. Otherwise only fine cencentric striæ of growth can be observed on the valve.

Neither the dorsal valve nor the interior characters of this species are known to me. Only so much can be stated, that the present species did not possess the characters of the genus *Marginifera*, which will be described next.

The measurements of a very complete, middle-sized specimen from Chidru are as follow :—

Length of the shell in a straight line	13 mm.
„ „ „ along the curve	26 „
Greatest breadth of the shell at the hingeline	14 „
Thickness of the ventral valve	8 „
Distance of the apex from the frontal margin	9 „

The largest specimen known to me is 16 mm. in length and 17 mm. in breadth.

Locality and geological position.—This species seems to be restricted to the *Cephalopoda*-bed of the upper division of the Productus-limestone, and is even there very rare. I have found it myself at Jabi (3 sp.) as well as at Chidru (1 sp.).

Remarks.—For a long time I was inclined to affiliate the present species to *Prod. spinulosus*, Sow., from the European mountain-limestone, as it agreed well with that species in size. But at least specifically the Indian shell seemed to be different from Sowerby's species by the very strongly elevated median and apical part of the shell, the smaller and less flattened wings, and by the occasional combination of the tubercles with longitudinal ribs. By all these characters, however, the present species approches *Prod. geinitzianus*, Kon., from permian beds of Europe. Thus it seemed on the whole safer to place the shell here under consideration among the allies of Mons. de Koninck's species. It is distinct from that form by its smaller size and constantly absent median sinus, but probably it is only a geographical variation or vicarious species for that permian shell. *Productus wallacianus*, Derby, might also be compared, but the figures are too bad to allow of a closer comparison.

1. GROUP OF PRODUCTUS KIANGSIENSIS, Kays.

18. PRODUCTUS TUMIDUS, Waagen, n. sp., Pl. LXXX, figs. 1,2, 3.

The size of the present species is always moderate, it never attaining any considerable dimensions. The general outline is transversely oval to squarish or even nearly cubical. The dorsal valve is evenly concave, not geniculated. The sculpture consists of a tolerably fine and not prominent radial plication, which becomes indistinct and irregular towards the margins, and on which not very numerous thin erect spines are irregularly distributed.

The ventral valve is moderately to very strongly inflated, and the curve is always very regular in the logitudinal direction. Transversely the valve appears flattened in the middle, and the lateral parts descend nearly vertically, so that very strongly inflated specimens appear nearly cubical. The wings are generally small, but sometimes bear an expansion which spreads out and descends vertically from the hingeline (Pl. LXXX, fig. 1*c* & 1*e*). The beak is not much incurved, pointed, and not or barely overhanging the hingeline. In strongly inflated specimens the apical region is highly elevated above that line. The sculpture consists of numerous low, broad, rounded radial ribs, which are tolerably regular on the visceral part of the valve, but become irregular as soon as they have passed that region, bending in various directions and splitting up into several finer ribs. A concentric sculpture does not exist, except along the hingeline, where several short folds are observable. There is a not very great number of erected spines irregularly distributed over the surface of the valve. On the apical region they are more numerous than elsewhere, and chiefly two diverging rows are always distinct, extending from the apex on both sides of the visceral part.

The dorsal valve is deeply and regularly concave, and its visceral part is most deeply excavated. The wings are concave and separated from the remainder of the valve by an obtuse ridge. A trace of a median fold is sometimes developed in this valve. The sculpture consists of fine and faint radiating ribs, which are interrupted from time to time by shallow grooves that correspond to the spines of the other valve. Two rows of such grooves are chiefly conspicuous extending along the ridges that mark off the wings from the remainder of the valve. Of spines not a trace is observable on this valve.

The interior characters of the species are absolutely unknown to me.

The measurements of the largest specimen are as follow:—

Length of the shell in a straight line	30 mm.
„ „ „ along the curve	48 „
Greatest breadth of the shell	30 „
Length of the hingeline	25 „
Thickness of the ventral valve	23 „

Locality and geological position.—The present species is to be met with rather frequently in the middle division of the Productus-limestone, and it occurs much more rarely in the upper division.

In the middle division it has been found on the road between Vurcha and Uchâli (1 sp.), at Morah (2 sp.), at Kálabágh hill (1 sp.), and at Káfirkot (3 sp.).

In the upper divison only the *Cephalopoda*-bed at Jabi has furnished me two specimens.

Remarks.—This species has been for long a great puzzle to me, and even now it is only in a provisorial way that I place it in the section "*Horridi,*" its systematic position being still to a certain extent doubtful.

The species to which it is most nearly related is on the one hand ***Prod. kiangsiensis***, Kays., and ***Prod. chandlessi***, Derby, on the other; but also one of the specimens figured by Koninck (Monogr. du Genre Productus, Pl. X. fig. 2, c. f.) under the name of ***Prod. longispinus***, Sow., must be compared. The difficulty of the classification appears already clearly from the systematic position that has been assigned by different writers to these allied species. Prof. Kayser puts his ***Prod. kiangsiensis*** into the "*Caperati*;" Prof. Derby places his ***Prod. chandlessi*** on the contrary in Davidson's "*Sublaeves*;" and ***Prod. longispinus***, Sow., is counted by Mons. de Koninck among the "*Semireticulati.*" I have placed my new species in the "*Horridi*" on account of the great resemblance certain specimens, in which the longitudinal striation becomes indistinct, acquire to the true ***Prod. horridus.***

Among all species by far the most nearly related to the present form appears to be ***Prod. kiangsiensis***, Kays. This species has been described by Kayser from the upper carboniferous beds of Lo-Ping in China, and is related to the present species by the similarity of the plication of the wings and the arrangement of the spines; it differs from it on the contrary by its smooth ventral valve on which a radial striation only exceptionally occurs, and by its smaller size. A small area occurs occasionally also in the Indian shell.

Productus chandlessi, Derby, from the coal-measures of Itaituba in Brazil, differs from the shell here under consideration by its generally more strongly developed wings, a faint reticulation in the apical region of the ventral valve, a smooth frontal part and a more irregular distribution of the erect spines.

Similar characters distinguish also Mons. de Koninck's *Prod. longispinus* from the present species.

VI.—SECTION: IRREGULARES.

m.—GROUP OF *PRODUCTUS STRIATUS*, Fischer.

19.—PRODUCTUS COMPRESSUS, Waagen, n. sp., Pl. LXXXI, figs. 1, 2.

1862. *Productus striatus*, (Fisch.) Davidson: Quart. Journ. Geol. Soc. Lond., Vol. XVIII, p. 31, pl. I, fig. 18.
1863. *Productus striatus* (Fisch., Davids.) Koninck: Foss. paléoz de l'Inde, p. 37. pl. X, fig. 18.

The general outline of this species is exceedingly variable, sometimes elongated, sometimes roundish, but always the shell is easily recognisable by the many concentric wrinkles it bears and by the wings which are vertically bent down.

The ventral valve is very variable in its inflation, and no constant characters can be indicated on this point. In the longitudinal direction the curve ascends sometimes rather rapidly from the apex, and becomes then more and more flattened towards the front; in other cases it remains rather flat in the apical region and then suddenly bends down to the front. Transversely the curve is somewhat more regular, but also variable, inasmuch as it is more elevated in elongated than in roundish specimens. A strange character consists in the circumstance that the valve is always so strongly compressed in the apical region that in a view from above the lateral margins are concealed below the overhanging lateral parts of the valve. The apex is thin, pointed, and bent over only at its extremity. A hingeline, properly speaking, does not exist. Immediately from the apex the wings, which are rather large and flat, bend vertically down, leaving a comparatively very small triangular space between them, and no room whatever for a straight hingeline. The wings are marked off from the remainder of the shell in some specimens by a flat impression, in others not, but the wings are always easily distinguishable by the spines they bear. There is not a trace of a median flattening or median sinus on this valve. The sculpture consists of very fine radiating lines, which are of equal breadth over the whole extent of the valve, augmenting frequently by intercalation, and bending well down on the lateral portions of the valve so as to reach the margins always at right angles. This longitudinal striation is crossed by numerous tolerably broad rather irregular concentric wrinkles, which are narrowly rounded on top and separated from each other by broad rounded valleys. These wrinkles are restricted to the median part of the valve, and do not extend on the wings. On these latter parts a varying number of irregularly bent long slender spines are situated, which are quite irregularly distributed and extend only a short way along the lateral margins of the valve. On the median part of the valve every trace of a spine is absent.

Of the dorsal valve only fragments are known to me. I only know that it is strongly concave, leaving but very little room between it and the ventral valve, and that it is also covered with a very fine longitudinal striation.

The interior characters of the species are also nearly quite unknown to me. All that I know is, that the dorsal valve bears a very strong and high median septum.

On account of the extreme variability of the outline of the species it appears barely practicable to give exact measurements. All that can be said is, that the species is always of a medium size, and that the dimensions may best be seen from the drawings on Pl. LXXXI.

Locality and geological position.—The species is not very rare in the middle division of the Productus-limestone, where it has been found at Khund (1 sp.), at Morah (3 sp.), at Vurcha (2 sp.), at Katwáhi (1 sp.), in the Chittawán near Ghari (1 sp.), and at Káfirkot (1 sp.).

West of Khura I collected a specimen of the species in the very lowest beds of the upper division of the Productus-limestone.

In the lowest division no specimen has been detected up to the present.

Remarks.—By Mr. Davidson this species has been considered as identical with *Prod. striatus*, Fisch., and I must here expose the reasons why I cannot concur with that learned author on this point. If one compares the true *Prod. striatus*, Fisch., with the present species, one soon finds that the wings, if they are not broken away, are always horizontally spread out; though they be very small, they are never bent down vertically from the hingeline. The concentric wrinkles are few in number and chiefly developed on the wings and lateral parts, disappearing in most cases on the median part of the shell: in *Prod. compressus*, on the contrary, the wrinkles are very numerous and most strongly developed on the median part, whilst they disappear entirely on the wings. These differences seemed to me sufficient to distinguish specifically between *Prod. striatus*, Fisch., and the present species.

The vertically bent down wings, which are not owing to any peculiar preservation of some of these shells, but which regularly occur in all the specimens, produce a very striking appearance in the species. In a lateral view the species thus resembles very much *Prod. ermineus*, Kon., but can easily be distinguished by the absence of a hingeline and the spines on the wings.

A shell which perhaps might be identical with *Prod. compressus* is the one figured by Kayser from upper carboniferous beds of Lo-Ping in China under the name of *Productus cora*, Orb. I would have considered this form as undoubtedly identical with mine, but that the concentric wrinkles appear to be somewhat sharper.

20. PRODUCTUS MYTILOIDES, Waagen, n. sp., Pl. LXXX, fig. 4.

The general outline of this species is triangular, mytiliform. The ventral valve is but little inflated, the wings small, and the concentric wrinkles are rather faint; a hingeline does not exist.

The ventral valve is but very little arched in the longitudinal direction, but its curve is very regular. Transversely the valve appears much more strongly vaulted, and chiefly in the apical region its curve forms about a semi-circle; towards the front the valve is only flatly arched. The apex is very strongly pointed, prominent, and but very little incurved. The wings are very small and vertically bent down; they bear a row of spines along their margins, and one or two scattered on their surface. The valve is covered by an extremely fine radial striation, which appears to be much finer than in *Prod. compressus.* While in the latter species there are generally eight to nine striæ within the space of 2 mm., there can generally be counted 12 to 14 striæ within the same space in the present one. The striæ are often very irregularly bent in various directions, and the shell appears often as if injured and again mended. As in other allied species the striæ are curved so as always to meet the margins of the valve at right angles. The spines which have been mentioned as occurring on the wings are the only ones that exist, the remaining surface of the valve being entirely devoid of spines. The concentric wrinkles are neither very numerous nor very distinct; they are, however, strongest on the median part of the valve.

The dorsal valve is very deeply concave from the apex, and this concavity is very regular. It has no wings, and no hingeline, but is narrowly rounded at the apex, the straight lateral margins reaching up to very near the apex. The front is rounded as in the other valve. The sculpture consists of a fine radial striation as in the other valve, and of indistinct irregular concentric wrinkles. Spines are entirely absent on this valve.

As in all the species allied to *Prod. striatus*, Fisch., so in this one the substance of the valves is extremely thin. Of the interior characters of this species nothing is known to me, except that the dorsal valve possessed no prominent median septum.

The measurements of a specimen from Jabi are as follow :—

Length of the shell in a straight line	51 mm.
„ „ „ along the curve	63 „
„ „ dorsal valve	52 „
Entire breadth of the shell	45 „
Thickness of the ventral valve	19 „
Distance of the two valves from each other	5 „

Locality and geological position.—There are altogether only two specimens of this species known to me, one entire and one fragmentary; they were both collected by myself in the *Cephalopoda*-bed of the upper Productus-limestone at Jabi.

Remarks.—This species approaches in its general appearance even more than the preceding one to *Prod. striatus*, Fisch., on account of its feeble concentric wrinkles. Specimens of Fischer's species, in which the wings are broken away, can only be distinguished by their coarser radial striation. In the specimens of *Prod. mytiloides*, however, the wings are not broken; they are well preserved, but not spread out horizontally, on the contrary bent down vertically, and this is a deciding character, which makes a distinction of the Indian shells from the mountain-limestone species absolutely necessary; as a consequence of this character there is the entire disappearance of a hingeline.

By these vertically bent down wings *Prod. mytiloides* very nearly approaches the *Prod. compressus*, W., described before. It is, however, distinct from that species by its smaller wings, its less sharp and distinctly developed concentric wrinkles and the much finer radial striation.

I have separated the two forms on these grounds in a somewhat provisional way, as the materials which have served for the description of the present species are rather scanty. Nevertheless, the shells from the *Cephalopoda*-bed seemed different from the others, and thus I have come to distinguish the new species; further investigations only will show whether I have been right in doing so or not.

Genus: MARGINIFERA, Waagen, n. gen.

Though species belonging with great probability to the present genus have been described already by several authors, yet no one has drawn particular attention to the rather strange characters by which it differs from *Productus* proper.

It must be admitted that these characters do not make their appearance suddenly, but that they are developed by degrees, so that in the Brachiopod fauna of the mountain-limestone the genus appears to be indicated but not well developed, and only in later geological periods its full development is attained. The observer who has most attentively described the peculiarities in question, and has most conscientiously figured them, is Geheimrath Abich, who has described several species in his monograph of the fossils from Djoulfa on the Araxes. But he deemed these peculiarities not sufficient for the establishment of a new genus.

According to my view, however, they are sufficient for such a purpose. If we consider the family of the *Productidæ* altogether, we find that the generic distinctions are rather difficult within the whole family, and that the limits of the different genera are rather uncertain. Such is the case with *Chonetes, Strophalosia, Aulosteges, &c.*, which all have been considered by many writers only as sub-genera of *Productus*. While however in those cases the distinguishing characters are external as well as internal, in the shells here under consideration the peculiarities are all internal and can be observed only when the shell is partly broken.

The shells which I consider as belonging to the present genus are always rather small, and never attain any considerable dimensions. In their external appearance they are absolutely like *Productus*, so long as the shell is not broken, but as soon as the shell-margin is removed, which very easily happens, the difference comes to light. The cause why the shell-margin so very easily breaks off is a thick prominent shelly ridge, placed vertically on the internal surface of the dorsal valve, and by which the visceral part of that valve is girt. In the ventral valve a similar ridge is developed within the wings only. In this way the visceral part of the shell is perfectly chambered off from the remainder of the shell. These prominent concentric ridges are sometimes finely striated and crenulated, sometimes smooth. The other internal characters are in all the specimens at my disposal (except in *Marg. typica*, W., where the description will be found) very indistinct, but on the whole they seem to be similar to those of *Productus.*

This strange chambering off of the visceral part by means of proper projecting ridges seems to me perfectly sufficient for the generic distinction of these forms, certainly it is as well worthy of notice as the existence of an area in *Aulosteges* or the like.

In the mountain-limestone this character is not yet well developed in any of the *Productus*-like shells. I have observed indications of such ridges in some specimens of *Prod. longispinus*, Sow.; in which species something of this kind has also been figured by Davidson (Mon. Brit. Carb. Brach., Pl. XXXV, fig. 9), and in *Prod. proboscidens*, Vern., but the development of these ridges is never anything like that occurring in the shells of the Salt-range. The geologically oldest species that probably must be considered as a true *Marginifera* is *Marg. splendens*, Norw. & Pratt., from the coal-measures of Illinois, Missouri and Indiana. I have no specimens of this species for comparison, but as far as can be judged from Norwood's drawings, fig. 5b seems to represent a true *Marginifera.* Among Mr. Trautschold's figures of *Producti* from the upper carboniferous limestone of Moscow, I find no specimens of *Marginifera.* Most numerously the genus seems to be represented in the permian beds of Djoulfa and the Araxes. Mr. Abich has distinguished two species: *Marg. spinosocostata*, Ab. sp. and *Marg. helica*, Ab. sp., which both have been united by Möller with *Productus horridus.* The occurrence of internal ridges, which have been very exactly described and figured by Abich, forbids such an identification.

On the whole it is probable that the genus has taken its origin from *Productus longispinus*, Sow., as all the forms of *Marginifera* appear to be more or less nearly related to Sowerby's species, but that species itself seems to possess the distinguishing characters not yet in sufficiently strong development to be considered as belonging already to the genus *Marginifera.* Only in somewhat more recent geological times, in upper carboniferous beds, the characters of the genus seem to have been quite well developed.

In the Salt-range the genus is rather largely represented, and extends through the whole thickness of the Productus-limestone. Species of the genus are chiefly numerous in the lower division of the formation, where not less than four species occur. The middle division is not so rich in species, but so much the richer in individuals. The same can be said of the upper division where two species occur, one of which is however rare and extends into the topmost beds of the whole formation.

Three of the species form together a well-marked developmental series; these are *Marginifera excavata*, W., a rather common species of the lower Productus-limestone; *Marg. typica*, W., the very common species of the middle and upper divisions; and *Marg. ornata*, W., a rare species of the *Cephalopoda*-bed and of the topmost beds of the upper Productus-limestone. All three are related to a certain extent to *Marg. splendens*, Norw. & Pratt. Two other species, both from the lower Productus-limestone, can be brought into connection with Abich's species of *Marginifera.* One of these is very nearly related to *Marg. spinosocostata*, Ab., and will bear the name of *Marg. ovalis*, W.; the other agrees to a certain extent with *Marg. helica*, Ab., and will be called *Marg. transversa*, W. At last there remains an isolated species, the relations of which are rather uncertain. It occurs also in the lower Productus-limestone and will receive the name of *Marg. echinata*, W. The species can thus be arranged in the following manner :—

a.—Group of MARGINIFERA SPLENDENS, Norw. & Pratt, sp.
 1.—*Marginifera excavata*, W.
 2.— „ *typica*, W.
 3.— „ *ornata*, W.

b.—Group of MARGINIFERA SPINOSOCOSTATA, Abich, sp.
 4.—*Marginifera ovalis*, W.

c.—Group of MARGINIFERA HELICA, Abich, sp.
 5.—*Marginifera transversa*, W.

d.—ISOLATED SPECIES.
 6.—*Marginifera echinata*, W.

I cannot recognise any of the Salt-range forms in any other locality of the world. Several species described by American authors might be compared to the Salt-range shells, but none is, according to my opinion, identical. It is true the establishing of identity depends to a great extent upon the extension one wishes to give to a species, and if one draws the limits of the single species rather wide, an identity will often be the consequence. Thus all the coal-measure species of America, which probably are for the greater part *Marginifera*, have been united by Mr. Davidson with *Prod. longispinus*, Sow., and yet I must consider *Marg. splendens*, *Prod. wabashensis* and *Prod. capacii* each as a different and well distinguishable species. Also the Indian *Marginifera typica* has been considered by Mr. Davidson as identical with *Prod. longispinus*, Sow. I however should not like to adopt this view. The true *Prod. longispinus*, of which I have some ten specimens for comparison, is different from the Indian form by the entire absence or very insignificant development of internal ridges bordering the visceral portions of the valves. This difference seems to me such an important one that I must consider the Indian shell as belonging to a different genus, and thus this latter cannot possibly be specifically indentical with Sowerby's species. The form with which an identity might perhaps exist is *Marg. splendens*, Norw. and Pratt, and I have in consequence made use of this name for the heading of the group to which my *Marg. typica* belongs.

a.—GROUP OF *MARGINIFERA SPLENDENS*, Norw. & Pratt, sp.

1. MARGINIFERA EXCAVATA, Waagen n. gen. et sp., Pl. LXXVIII, figs., 2, 3.

This species is always of rather small dimensions and of a somewhat transversely oval or even almost transversely rectangular outline. The apical region is tolerably prominent, the ventral valve inflated and covered by a radial striation bearing a great many long slender spines, which are directed forward. The dorsal valve is concave, devoid of spines, and bears many elongated grooves.

The ventral valve is very strongly inflated and enrolled, forming a not very regular open spiral. The umbonal part of the valve is very strongly prominent in adult specimens, less so in young ones, and is highly elevated above the hingeline. In the transverse direction the valve appears somewhat rectangular, the median part being strongly flattened or even impressed, and the sides descending nearly vertically to the lateral shell-margins. The wings are very small, pointed, and but little arched; if entirely preserved they mark the greatest breadth of the valve. The apex is strongly incurved, pointed, and well overhanging the hingeline. A well-developed sinus is not present on the valve. The sculpture consists of not very distinct radial ribs, which are not very numerous; they are crossed on the visceral part of the valve by indistinct irregularly wavering concentric wrinkles, which do not descend to the hinge-margin. The longitudinal ribs are provided from distance to distance with long slender spines, which are bent forward very near the root. These spines are more numerous on the lateral than on the median parts of the valve, and along the hingeline two tolerably distinct rows of them can be made out. The remaining surface of the valve is covered by very fine concentric striæ of growth.

The dorsal valve is deeply and evenly convave, only the little wings being somewhat flattened. The whole valve *is covered by irregular not very strong concentric* wrinkles, while a radial sculpture is entirely absent. Instead of it numerous radially arranged elongated grooves can be observed, which give to this valve a very characteristic appearance.

Of the interior characters of this species but very little is known to me. Only the existence of the internal ridge, characterstic of the genus *Marginifera* can be stated with certainty.

As has been said before, the species never attain considerable dimensions; the largest specimen known to me shows the following measurements :—

of the shell in a straight line	20 mm.
„ „ „ along the curve	44 „
„ „ smaller valve in a straight line	10 „
Greatest breadth of the shell at the hingeline	20 „
Thickness of the shell	13 „

Locality and geological position.—The species is not very rare at certain places in the lower division of the Productus-limestone. It seems to have been a species that lived in the immediate vicinity of the shore, as I have found it only in the Nílawán at different places, associated everywhere with many fragments of wood, &c., indicating a shore-deposit. The Nílawán is at the same time the first place to the east, where in the Salt-range the fossiliferous beds of the lower Productus-limestone make their appearance. The species is numerous there, but it is difficult to obtain specimens, as they are all very brittle and fall to pieces when extracted from the rock. I brought away only two well-preserved specimens.

Remarks.—The present species appears to be very nearly related to *Productus longispinus*, Sow., as defined by Davidson. The ventral valve shows a difference from the same valve in Sowerby's species by the more numerous spines which are chiefly crowded together on the lateral parts of the valve and by a more prominent visceral region. The dorsal valve of *Marg. excavata* is by its elongated grooves so characteristic and peculiar that it needs no comparison with the same valve of *Productus longispinus*.

Marg. splendens, Norw. and Pratt, has a distinct sinus in the ventral valve, also less numerous spines and a quite different dorsal valve.

It seems thus that our species is a well distinguishable form, which still bears a great resemblance to *Marg. typica* which will be described next. The differences consist in a less prominent visceral part, more numerous spines, more irregular concentric wrinkles in the apical region and an entirely peculiar dorsal valve in our *Marg. excavata*.

2. MARGINIFERA TYPICA, Waagen, n. gen. et sp., Pl. LXXVI, figs. 4—7; Pl. LXVIII, fig. 1.

1862. *Productus longispinus*, (Sow.) Davidson: Quart. Journ. Geol. Soc. Lond., Vol. XVII, p. 31, pl. I, fig. 19.

1863. *Productus longispinus*, (Sow., Dav.) Koninck: Foss. paléoz. de l'Inde, p. 37, pl. X, fig. 19.

Most specimens of this species have a very strongly inflated ventral valve with an extremely prominent apical region, well-developed wings, which are, however, often broken away, and a not very deeply concave dorsal valve which is excellently characterised by a row of grooves placed on the limit between the wings and the remainder of the valve. The species, however, never attained any considerable size, but remained always rather small.

The ventral valve is very much inflated, nearly spirally enrolled, and the visceral part is very strongly prominent above the hingeline; the curve is, however, not equal in either direction. Longitudinally the apex appears well bent in, but very near the apex already a considerable flattening of the valve takes place, which continues to the point where the valve appears most highly elevated above the hingline, then the flattening suddenly changes into the regular spiral curve. In the transverse direction the median part of the valve appears distinctly flattened and impressed, while the lateral parts are bent down nearly perpendicularly. The wings are very large, not pointed at their extremities, more or less spirally enrolled, and separated by a deep furrow from the remainder of the shell. When they are preserved, as is comparatively rarely the case, the general shape of the valve appears considerably broader than it is long, otherwise the breadth and length of the valve are about equal, and then the general outline appears somewhat squarish. Only young specimens have a more or less transversely oval outline. The apex is not much bent over, strongly pointed, prominent and somewhat overhanging the hingeline. At a short distance from the apex a well-developed, not very broad, but rather deep sinus commences, which extends down to the front, though it often becomes somewhat more shallow in the frontal region. The sculpture of the valve consists in a fine radial plication which is about parallel up to a certain somewhat variable distance from the apex, and then begins to converge from both sides towards the middle of the median sinus. This fine plication continues mostly within the sinus down to the frontal margin, but on the elevated lateral portions of the valve several of the fine ribs unite indistinctly into a few coarse ones, on which then more or less numerous, irregularly placed, erect spines are situated (see Pl. LXVIII, fig. 1). In the apical region the radial folds are crossed at a greater or less distance by rather indistinct concentric ribs. On this indistinctly reticulated part of the valve there are more or less numerous fine spines quite irregularly distributed. Also, very regularly a distinct row of spines is to be observed along the furrow which separates the wings from the remainder of the valve. The wings are smooth or provided only with a faint concentric sculpture. Spines are always wanting on them.

The dorsal valve is very deeply concave. The wings are flattened or slightly concave, separated from the remainder of the valve by angular, strongly prominent divering ridges. Towards the front a not very strong median fold is developed. The concave part of the valve is rather distinctly reticulated in the apical region. Lower down only a fine regular radial plication remains. The whole reticulated part is irregularly strewn with little round shallow grooves, corresponding to the spines on the other valve. Two rows of these grooves are, however, most conspicuous; they extend inside along the ridges which separate the wings from the remainder of the shell. Prominent spines are absent on this valve.

I encountered great difficulties in making out the internal characters of this species, and only quite recently I succeeded in making some preparations showing these characters; they are represented in the subjoined wood-cut.

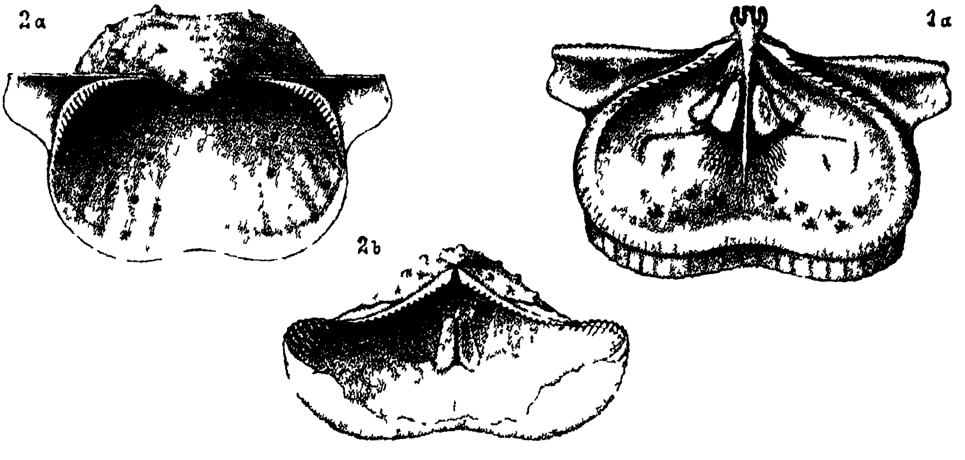

Fig. 23. Marginifera typica, Waagen, n. gen. et sp. Dorsal and ventral valves of one and the same specimen from the Cephalopoda bed of Jabi. 1a, dorsal valve, internal view, strongly enlarged; 2a, ventral valve, internal view, enlarged; 2b, front view of the same, the wings broken off, also enlarged.

The ventral valve is very peculiar, and deviates very far from the corresponding valve of *Prod. longispinus*, Sow. As regards the muscular impressions only the adductor impressions are quite distinctly visible. They are situated on both sides of the middle line of the valve and are narrowly elongated in shape. The divaricator impressions are not so distinct. They are certainly not striated longitudinally, seem to be roundish in shape, rather large and situated outside and on a level with the adductors. The ridges, characteristic of the genus, commence inside under the apex. They leave a narrow slit in the middle between them for the passage of the cardinal process of the other valve. They are not very high in this part of the valve, run down along the hingeline up to the commencement of the wings, then suddenly become high and sharp and bend round in a broad curve to join the lateral parts of the valve, leaving the wings free. In the frontal part the ridge dwindles down to a mere prominent line. The ridges are all along more or less strongly crenulated on top.

In the dorsal valve the internal characters are rather complicated. The cardinal process is short, quite sessile, not pediculated. It is somewhat belt-shaped; deeply hollowed out on its lower or external face and slightly vaulted on the upper or internal face. Its margin is deeply slit open on the lower face and cut into three lappets on its upper one. The cardinal process is continued on the inner side of the valve as a long but not very high median septum. Where the process is joined to the body of the valve there are on both sides a kind of dental grooves for the reception of the commencement of the internal ridges of the other valve. Outside and somewhat below these grooves the marginal ridges of this valve take their origin. They are so disposed as to fit within the ridges of the other valve. In the commencement they are sharp, but low and narrow, crenulated on their outer side, and remain so down to nearly the end of the wings; then they begin to become broader, and to be bent at the same time outward. In this condition they show a convex inner or upper face and a concave outer or lower one. The upper face is very finely transversely striated, whereby the margin appears under the lens to be very finely crenulated. This broad part of the ridge extends without interruption over the lateral and frontal parts of the valve. In the apical region outside of the ridge just described are rather deep and broad furrows, which serve for the reception of the ridges of the other valve. After this a very strongly thickened hinge-margin follows and extends to the end of the wings. In the median part of the valve, rather more approached to the apical region, the muscular impressions are placed on both sides of the median septum. The two pairs of adductor impressions are very strongly distinct from each other. The inner pair is large, somewhat reniform and very strongly raised above the surrounding parts of the valve. The outer pair on the contrary is much smaller, elongated, oval and situated in hollowed-out grooves. The brachial ridges are not well preserved in any of the specimens at my disposal. They seem to be low, filiform and simply hook-shaped. The internal surface of the valve is all over finely granulated. In the frontal region, within the marginal ridge, some larger spines seem to have existed.

The substance of both valves is always very thin.

The measurements of two specimens—No. I, the largest one known to me, from Jabi, and No. II, a middle-sized specimen from the upper Productus-limestone of Swás, are as follow :—

	I.	II.
Length of the shell in a straight line	21 mm.	17 mm.
„ „ „ along the curve	42 „	33 „
„ „ smaller valve in a straight line	12 „	10 „
Breadth of the shell with the wings	31 „	24 „
„ „ „ without the wings	17 „	17 „
Thickness of the ventral valve	14 „	10 „
Distance of the two valves in the visceral region	10 „	7 „

Locality and geological position.—The present species is one of the more common ones of the Productus-limestone. It occurs chiefly in the middle and upper divisions of the formation, while in the lower division no characteristic specimens of the species have been found up to the present.

The geologically oldest specimen was collected by myself at Nursing Pohár, in a black limestone of which the lowest beds of the middle Productus-limestone are there composed. In the higher beds of the middle Productus-limestone the species has been found at Vurcha (1 sp.), on the road between Vurcha and Uchâli (7 sp.), in the Chittawán (3 sp.), at Morah (1 sp.), in the Bazárwán (1 sp.), in the Bukh ravine (1 sp.), and at Swás (9 sp.). Trans-Indus the species has been collected by myself and by Dr. Verchere at Káfirkot (8 sp.), and by Mr. Wynne, north of that locality (8 sp., all on one piece of rock). In the section near Khura I collected the species in the top beds of the middle division (1 sp.).

The upper division is not so rich in specimens of this species. I collected the shell west of Khura in the lowest beds of the upper division (6 sp.), at Nanga (1 sp.), in the *Cephalopoda*-bed at Jabi (7 sp.), and in the same bed at Chidru (3 sp.).

The species does not extend into the topmost beds of the upper division but is replaced there by another form.

Remarks.—Mr. Davidson has identified the present species with *Prod. longispinus*, and it cannot be denied that a great resemblance exists between the Indian shell and Sowerby's species. This similarity is, however, more apparent than real. Even in the external characters of the two species there are differences which make a distinction possible. Before all there is the visceral part in the Indian shell much more prominent and elevated above the hingeline. Then also the radial striation is different; while in *Productus longispinus* the ribs are fine and of about equal width for the whole length, in *Marg. typica* several of these ribs unite as soon as they have passed the visceral part, so that only a few strong folds remain on which the spines are placed. The specimen figured by Davidson is in this respect a somewhat exceptional one, as at this size the union of the ribs has generally already taken place.[1] But on the other hand Mr. Davidson figures so distinctly the marginal ridge, which forms the distinguishing character of the genus that I cannot but believe Mr. Davidson's specimen identical with my *Marg. typica.*

That this shell must be distinguished specifically and even generically from *Productus longispinus* is most clearly shown by the internal characters, which have been described above, and which are very peculiar.

In India the *Marg. excavata* described previously is most nearly related to the present species. The differences between the two consist in a finer radial sculpture, the absence of a sinus in the ventral valve, spines that are directed forward, and in an entirely different dorsal valve in *Marg. excavata.*

Of other species *Marg. splendens,* Norw. and Pratt, must chiefly be compared. This American form agrees with the Indian shell in so far that the fine radial striation appears also to be restricted to the visceral part, but it is already distinct by its thick shell and the occurrence of spiny tubes on the wings, which are never to be found on *Marg. typica.* Also *Marg. spinosocostata,* Ab., from permian beds of Djoulfa is similar to our Indian species, but the concentric sculpture in the vicinity of the apex is less strongly developed, a radial striation is wholly absent, the radial sculpture being composed only of coarse ribs, and a median sinus is barely indicated in the ventral valve of Abich's species, and thus it can well be distinguished from *Marginifera typica.*.

3. MARGINIFERA ORNATA, Waagen, n. gen. et sp., Pl. LXXVII, figs. 5, 6.

This is a very rare species; only two specimens of it have been detected up to the present in the Salt-range. It is of rather small size and of a transverse outline, but the exact shape of this outline I am not able to indicate, as in both specimens the wings, which so easily fall off in the genus *Marginifera,* have been broken away. Without the wings the outline is transversely oval or somewhat trapezoidal, the greatest breadth being situated not far from the front. The radial sculpture consists partly of a fine striation, partly of coarse ribs, but the most characteristic feature of the species consists in a very strong and neat concentric sculpture in the vicinity of the apex.

The ventral valve is very strongly curved, nearly spirally enrolled. In the longitudinal direction this curve is, however, rather irregular, the visceral part being considerably flattened. In the transverse direction the lateral parts appear strongly depressed, the outline running down nearly vertically, and the median part is highly elevated, flattened and impressed in the middle. The apex is pointed, strongly prominent and incurved, and overhangs the hingeline very distinctly. At a very short distance from the apex a very deep median sinus commences, which extends down to the front. The sculpture of this valve is very similar to that of the preceding species. It consists of a fine radial striation within the sinus and on the lateral portions of the shell as far as the visceral part extends. Lower down this sculpture changes on the two lateral lobes into coarse ribs, which bear many spines. On the visceral part of the valve, however, in opposition to *Marg. typica,* is a very strong and neat concentric sculpture, which is stronger than the radial one and determines the character of the shell. This sculpture consists of fine concentric folds, which start from the hingeline and extend up to a row of spines that separates the wings from the remainder of the shell. At these spines each of the folds bifurcates, and then runs in an elegant curve to the other side. Besides the two regular rows of spines, which have just been mentioned, there are many other spines irregularly distributed over the surface of the valve.

The dorsal valve is deeply concave, most so in the apical region. The wings are flattened and highly elevated, separated from the remainder of the valve by a narrowly angular ridge. Within these ridges on each side is a row of round shallow grooves corresponding to the row of spines on the other valve. The median part of the valve is covered with a fine radial plication, which is interrupted at intervals by faint concentric folds and roundish shallow grooves. Spines are absolutely absent on this valve.

Of the internal characters of this species nothing is known to me, except what has been figured Pl. LXXVII, fig. *6c*: these are, the very distinctly developed marginal ridges of both valves, which have come to light by the breaking off of the wings, and of that part of the shell which has been called in other *Producti* the "trail."

The measurements of a specimen from Amb, without the wings, are as follow :—

Length of the shell in a straight line	15 mm.
" " " along the curve	29 "
Length of the dorsal valve	10 "
Breadth of the shell without the wings	16 "
Thickness of the ventral valve	10 "

Locality and geological position.—There have up to the present only two specimens of this species been detected. Both were collected by myself, one in the *Cephalopoda*-bed at Jabi, the other at Amb in the grey sandstones forming the topmost beds of the Productus-limestone.

It thus appears that the species is restricted to the higher beds of the upper division of the Productus-limestone.

Remarks.—This species appears to be very nearly related to the preceding one, and it could also perhaps be compared to *Prod. longispinus.* It can, however, be distinguished from that species by the same character as the preceding one, and by the strong concentric plication of the apical part.

This latter character is also the one by which a distinction of the present species from *Marg. typica* is possible, and to which the name *ornata* is intended to allude. It might perhaps seem to be not quite correct to found a species on the occurrence of this character alone; but if one observes that the specimens bearing this character are restricted only to the upper region of the upper Productus-limestone, and that one of these specimens came from the top-beds where Brachiopoda are altogether rare, it seems practical to distinguish these specimens from *Marg. typica* under a proper specific designation, in order to mark the difference of geological horizon of this special form.

Marg. excavata, W., differs from the present species by the same characters by which it differs from *Marg. typica*, W.

Abich's species of *Marginifera* cannot be compared in particular with the form here under consideration, as they are both nearly devoid of a concentric sculpture.

b.—GROUP OF *MARGINIFERA SPINOSOCOSTATA*, Abich, sp.

4. MARGINIFERA OVALIS, Waagen, n. gen. et sp. Pl. LXXVII, figs. 1—4.

The general outline of this species is somewhat squarish or transversely oval. The visceral part of the ventral valve projects very far above the hingeline, and the sculpture of the valve consists in coarse radial ribs bearing rather numerous spines at irregular distances. A fine radial striation, as observed in the forms belonging to the preceding group, is absolutely absent. A concentric sculpture is indicated in the vicinity of the apex, but very little developed.

The ventral valve is very strongly inflated and nearly spirally enrolled. The curve is very regular in the longitudinal direction, and also transversely it is not much deformed. The sides descend rather abruptly, and the median part is flattened and distinctly impressed in the middle. The wings are always small, not enrolled. but also not much flattened, and of about rectangular outline. If they are preserved, which is not often the case, the greatest breadth of the shell is indicated by the termination of the wings. The apex is inflated, pointed, strongly incurved, but very little overhanging the hingeline. Mostly rather far away from the apex a distinct, sometimes even very deep, sinus commences, extending to the front. The sculpture consists of thick irregularly interrupted radial ribs, which are rather far distant from each other, and bear at irregular distances strong spines, which are strewn over the whole shell surface and are to be found in the apical region as well as on the wings, though they are rare on the latter. Sometimes a more distinct row of spines can be distinguished on the limit between the wings and the body of the valve. In the apical region also a concentric sculpture occurs, consisting of slight folds, but only rarely so strong as in my fig. 2, Pl. LXXVII.

The dorsal valve is deeply concave, with a more or less prominent broad median fold in the middle. The small wings are nearly quite flat, sometimes slightly reflected. They are separated from the remainder of the valve by a broad rounded ridge, within which often a row of grooves can be observed, as in *Marg. typica*, but this row is not constantly present. Otherwise the sculpture of the valve consists in irregularly arranged shallow grooves, between which sometimes a faint radial plication exists, but mostly this plication is absent; only on the "trail," outside of the marginal ridge, it is of more general occurrence. A concentric plication is barely indicated in any of my specimens. Prominent spines are also altogether absent on this valve.

Of the interior characters of this species, only the existence of the apparatus of marginal ridges can be stated, as has been figured in Pl. LXXVII, figs. 3 and 4.

The measurements of the largest specimen known to me are as follow :—

Length of the shell in a straight line	16 mm.
„ „ „ along the curve	32 „
Length of the dorsal valve	12 „
Breadth of the shell with the wings	17 „
„ „ „ without the wings	16 „
Thickness of the ventral valve	11 „
Distance of the two valves from each other	6 „

Locality and geological position.—The present species is entirely restricted to the lower Productus-limestone, and is most numerously represented in the lowest beds of that division. The number of localities where it occurs is, however, very small. In really great numbers the species occurs at Amb, in the black coaly sandstones which form there the lowest fossiliferous bed above the "lavender-clays." I brought away from there some twenty specimens. At the same locality the species extends into somewhat higher beds, as I collected there a specimen in the bed with *Chonetes ambiensis*, W., the *Chonetes*-bed as I have generally called it in this work. The species is, however, very rare in this bed.

Besides at Amb I collected the species only at Katta in yellow sandstones, very low down in the lower division of the Productus-limestone (bed No. 10 of the section in my note-book).

Remarks.—The most striking character of the present species by which it can be distinguished from the greater number of other forms is the entire absence of a fine radial plication in the apical region, and thus the absence of the reticulation which in many other species is so well developed round the apex. This character is one which must be attributed to the whole group of forms to which the present species belongs, and it has been very properly remarked by Abich that just this character prevented his uniting the *Marginifera spinosocostata*, with *Prod. longispinus*, with which species it otherwise seemed to be very nearly related. Prof. Möller, on the contrary, has united Abich's *Productus spinosocostatus* with *Productus horridus*. A certain similarity of Abich's species, as well as of the form here under consideration, to *Prod. horridus* cannot absolutely be denied, but this similarity is certainly only an external one. The young specimens of *Prod. horridus*, figured by Geinitz and King, to which Mr. Möller refers, have certainly got no internal marginal ridges, and are therefore no *Marginifera*. If specimens with such ridges should occur in the European Zechstein, which I cannot absolutely deny, as I have not got efficient materials from that formation, they would have to be distinguished from *Prod. horridus* as separate species as well as the Armenian and Indian specimens of *Marginifera*.

The distinction between *Marg. spinosocostata*, Ab., and *Marg. ovalis*, W., is not quite easy, and I was for long in much doubt whether I should not unite the two. At last I have decided to the contrary. I found the specimens of *Marg. ovalis* always to be broader than long, while the contrary is the case in *Marg. spinosocostata*. Then the sinus is always strongly developed in my species, while it is entirely absent or barely distinguishable in the Armenian shell. Finally, the young forms of the two species are entirely different; to see this, one need only compare fig. 8, Pl. IX, of Abich's work with my figures. Thus I thought it best to distinguish the two, all the more as their geological age is probably different. The Armenian species has been stated by Möller to be of permian age; the lowest beds of the Salt-range Productus-limestone are probably somewhat older, so that the Armenian species would probably be the descendant of the Indian shell.

c.—Group of *MARGINIFERA HELICA*, Abich, sp.

5. **Marginifera transversa**, Waagen, n. gen. et sp., Pl. LXXVIII, figs. 4, 5.

The general outline of this species is very strongly transverse, oval or somewhat trapezoidal, its breadth being just twice the length. Nevertheless is the shell very strongly inflated, but nearly devoid of any sculpture, ornamented only by numerous long thin spines directed forward.

The ventral valve is extremely strongly inflated, its thickness being nearly equal to its length, but the curve is very irregular in the longitudinal direction. The apex is distinctly bent in and rounded; then follows a long flattened space which terminates in a strong geniculation of the valve; after which it descends abruptly, but yet forming a well-rounded curve to the frontal margin. In the transverse direction the valve appears broadly flattened on top, somewhat impressed in the middle, while the lateral parts descend nearly vertically to the margin. There are rather large wings on both sides of the apex; they are flattened and terminate in acute angles. A very long straight hingeline extends along these wings, and occupies the greatest breadth of the valve. The wings fall off very easily, as in all species of *Marginifera*, and then the greatest breadth of the valve is situated lower down, not far from the front. The apex is small, pointed, barely prominent, and not or barely overhanging the hingeline. A very shallow sinus is developed either not far from the apex, or where the valve appears geniculated. Though the shell seems on a first glance nearly quite smooth and shining, yet on a close inspection two systems of very faint sculpturing can be observed. The radial system consists of not numerous fine narrow ribs, on which the spines are placed, and of a concentric system extending as far from the apex as the flattened space of the valve, and consisting of very irregular faint concentric wrinkles. The radial ribs generally appear only where the concentric wrinkles can no longer be observed. The spines, which are a very characteristic feature of this species, are distributed on the radial ribs, and in consequence they are absent on the flattened part of the valve, only exceptionally a sporadic spine occurring also on this part. On the wings spines are rare. There is on the contrary very regularly a row of spines at the limit between the wings and the remainder of the shell. On the deflected part of the valve the spines are very numerous, but they are quite irregularly arranged. The nearer the shell-margin the more numerous they become. The spines themselves are very thin and very long. They have been drawn much too thick and short in Pl. LXXVIII, figs. 4 *e* and *f*. The direction has, however, been rightly represented there. The margin of many specimens is girt by them as by a thickly set fringe.

The dorsal valve of this species is but very imperfectly known to me. It seems to be rather deeply concave and nearly quite smooth, only showing two diverging rows of flat roundish grooves at the limit between the wings and the remainder of the shell. Prominent spines seem to be entirely absent, at least as far as is known to me.

Of the internal characters only the existence of marginal ridges, characteristic of the genus *Marginifera*, can be stated; they are well and strongly developed.

The measurements of a well-developed full-grown specimen from Amb are as follow :—

Length of the shell in a straight line	11·5	mm.
„ „ „ along the curve	21	„
Distance of the front margin from the hingeline	10	„
Greatest breadth with the wings (hingeline)	22	„
„ „ without the wings	18	„
Thickness of the ventral valve	10	„

Locality and geological position.—Up to the present this species has been detected only at a single locality of the Salt-range, this was at Amb in the lower division of the Productus-limestone. I found it there not very rare (9 sp.) in the *Chonetes*-bed.

Remarks.—It is of much geological interest that the present form also is so very nearly related to one of Abich's permian species; and the affinity is really a very close one. *Marg. helica*, Ab., agrees with our species in the smooth shining shell with its strong silky lustre, as well as in the always transverse general outline. The difference consists chiefly in the regular curve of the ventral valve in *Marg. helica*, while the same valve is geniculated in *Marg. transversa*. Also the regular row of spines on the limit between the wings and the remainder of the ventral valve, which is very regularly present in the latter species, constitutes a distinguishing character. These characters, of which chiefly the first is very striking, are, I think, quite sufficient for the specific distinction of the Indian shells from the Armenian ones.

There is here again the same circumstance to be taken into consideration, to which we have drawn attention already with respect to the preceding species. In this case also it is probable that the Indian shell is the geologically older one, whilst the Armenian one belongs to a geologically somewhat younger horizon. It is now a very strange fact that the two developmental series to which *Marg. ovalis*, W., and *Marg. transversa*, W., belong have had no descendants in more recent beds in India itself, as in the middle and upper divisions of the Productus-limestone the genus *Marginifera* is only represented by the descendants of *Marg. excavata*, W., while they have propagated well in far-distant countries, as in Armenia, where their descendants are to be found in great numbers. This is a fact not without interest, but to explain why it has been so is absolutely impossible for the present.

Mr. Möller has united *Marg. helica*, Ab., with *Productus horridus*, Sow. I have explained already above the reasons why this should not be done.

d.—*ISOLATED* species.

6. MARGINIFERA ECHINATA, Waagen, n. gen. et sp., Pl. LXXVIII, fig. 1; Pl. LXXV, figs. 7, 8.

The general outline of this very elegant little species is transversely oval, the greatest breadth of the shell coinciding with the hingeline, if the wings are preserved, if not, as is very often the case, then the greatest breadth is situated about in the middle of the longitudinal diameter of the shell. The sculpture of the shell consists of a great many radial rows of fine species, which latter are otherwise arranged approximately in quincunx.

The ventral valve is very strongly inflated. The curve is, however, unequal in the longitudinal direction; the apex is very little incurved, and from the point of it to about the middle of the shell extends a flattened space, after which the valve is rather suddenly curved, whereby a kind of geniculation is produced. The frontal part is again rather flattened, not much curved. In the transverse direction the outline ascends rather rapidly from the margins, and is flattened on the median part of the valve, with a slight depression in the middle. The wings are not preserved in any of the specimens of ventral valves I have for description. In all these specimens they are broken off along the internal marginal ridge. The apex is pointed, prominent, but not bent over. At a rather considerable distance from it a median sinus commences, which is mostly rather deep and well developed, and which extends down to the front. The sculpture is very peculiar and easily recognisable; it is composed of two systems of very fine folds, of which one bears a great number of thin spines: this latter is the radial system, which is composed of 32 or 33 rather indistinct radial ribs, each of which bears at least ten spines before it reaches the frontal margin. The spines are so arranged as to alternate on two adjacent ribs where they appear placed in quincunx. The concentric sculpture is developed chiefly only on the visceral part of the valve. The wings, it seems, are quite smooth, bearing neither a radial nor a concentric sculpture, but where the wings are united to the body of the valve, the concentric sculpture commences. It consists of many fine wrinkles, which are chiefly distinct on the lateral parts of the valve, and often disappear entirely on the median part, but in other specimens they are also here quite distinct. Of other features of sculpture there may yet be mentioned the existence of two distinct rows of spines where the wings are united to the body of the shell.

The dorsal valve is nearly always disunited from the ventral one, and I have no specimen in which the two valves are in natural position. Isolated dorsal valves might easily be taken for strange *Producti* with flat valves, of the group of *Productus latirostratus*, Howse. This dorsal valve is very flatly concave with flatly spread out wings. These latter are very rarely broken off, quite the opposite of what is generally the case in the ventral valve; they are entirely flat, quite smooth without any sculpture, and separated from the remainder of the valve by a low angular ridge. On the interior side of this ridge a row of shallow round grooves is situated. The whole median part of the valve is covered down to the frontal margin by distinct concentric wrinkles, between which many shallow grooves, corresponding to the spines of the other valve, are disseminated.

Of the interior characters of this species but very little is known to me. In the ventral valve the marginal ridges, characteristic of the genus *Marginifera*, are very strongly developed, which is evidently the reason why the wings so very easily fall off. In the dorsal valve on the contrary these ridges are very weak and little developed. In the figure, Pl. LXXV, fig. 7, the specimen is seen from the interior side, but the shell is only preserved in the frontal region. As will be remarked in the enlarged figure, the ridge is indicated, but very low and little prominent. In this respect the present species most nearly approaches *Prod. longispinus*, Sow. Of the other remaining interior characters nothing is known to me.

The substance of the shell is very thin in both valves.

The measurements of a ventral valve, devoid of its wings, are as follow:—

Length of the shell in a straight line	14	mm.
„ „ „ „ along the curve	21	„
Distance of the frontal margin from the hingeline	12	„
Greatest breadth of the shell	19	„
Thickness of the ventral valve	9	„

Locality and geological position.—The present species has as yet been found only at a single locality in the Salt-range. This is in the Nílawán below Bhal, where the species occurs in a white sandstone representing the lowest fossiliferous beds of the Productus-limestone series. The fossils are found there more or less in nests clustered together, and some of these nests are entirely made up of the shells of the present species. It thus happened that in a small rock specimen I brought away, not less than ten specimens of the species were contained. The same bed in which the present species occurs is also very rich in *Fusulinæ*.

Remarks.—The present species is very peculiar in its sculpture, and cannot well, as far as I am aware, be compared to any other species of *Marginifera* or *Productus*. The only species which might perhaps be adduced as bearing some resemblance is *Prod. spinulosus*, Sow., or *granulosus*, Phill., but both these forms are different by the absence of radial ribs on which the spines would be placed. The same character distinguishes also the present species from my *Prod. opuntia*, previously described.

PLATE LVIII.

PRODUCTUS-LIMESTONE.

Figures 1—6. CHONETES AMBIENSIS, Waagen, n. sp., p. 618. Six specimens from the lower Productus-limestone (*Chonetes*-bed) of Amb. Fig. 1, largest specimens known to me ; 1*a*, ventral view ; 1*b*, dorsal view ; 1*c*, lateral view ; 1*d*, longitudinal section,—these four figures natural size ; 1*e*, *f*, *g*, enlarged ventral, dorsal and lateral views. Fig. 2, middle-sized specimen ; 2*a*, *b*, *c*, ventral, dorsal and lateral views, natural size ; 2*d* (6*a* on Plate), area enlarged. Fig. 3, small specimen somewhat broken at the margins ; 3*a*, *b*, *c*, *d*, ventral, dorsal and lateral views and longitudinal section, natural size ; 3*e*, area enlarged. Figs. 4 and 5, internal views of the ventral valve enlarged (the small cardinal teeth on both sides of the deltidial fissure have been omitted by the artist). Fig. 6, internal view of the dorsal valve enlarged.

7—9. LEPTÆNA (?) INDICA, Waagen, n. sp., p. 609. Three specimens from the lowest beds of the middle Productus-limestone of Katta. Fig. 7*a*, ventral view ; 7*b*, dorsal view ; 7*c*, lateral view ; 7*d*, longitudinal section,—these four figures natural size ; 7*e*, *f*, *g*, ventral, dorsal and lateral views, enlarged. Fig. 8*a*, *b*, *c*, ventral, dorsal and lateral views, natural size. Fig. 9*a*, *b*, *c*, the same, other specimen.

10. CHONETES STROPHOMENOIDES, Waagen, n. sp., p. 628. Specimens with preserved shell, probably from the lowest beds of the middle Productus-limestone of Swás ; 10*a*, ventral view ; 10*b*, dorsal view,—both natural size ; 10*c*, *d*, *e*, *f*, dorsal, ventral and lateral views and longitudinal section,—all four figures enlarged.

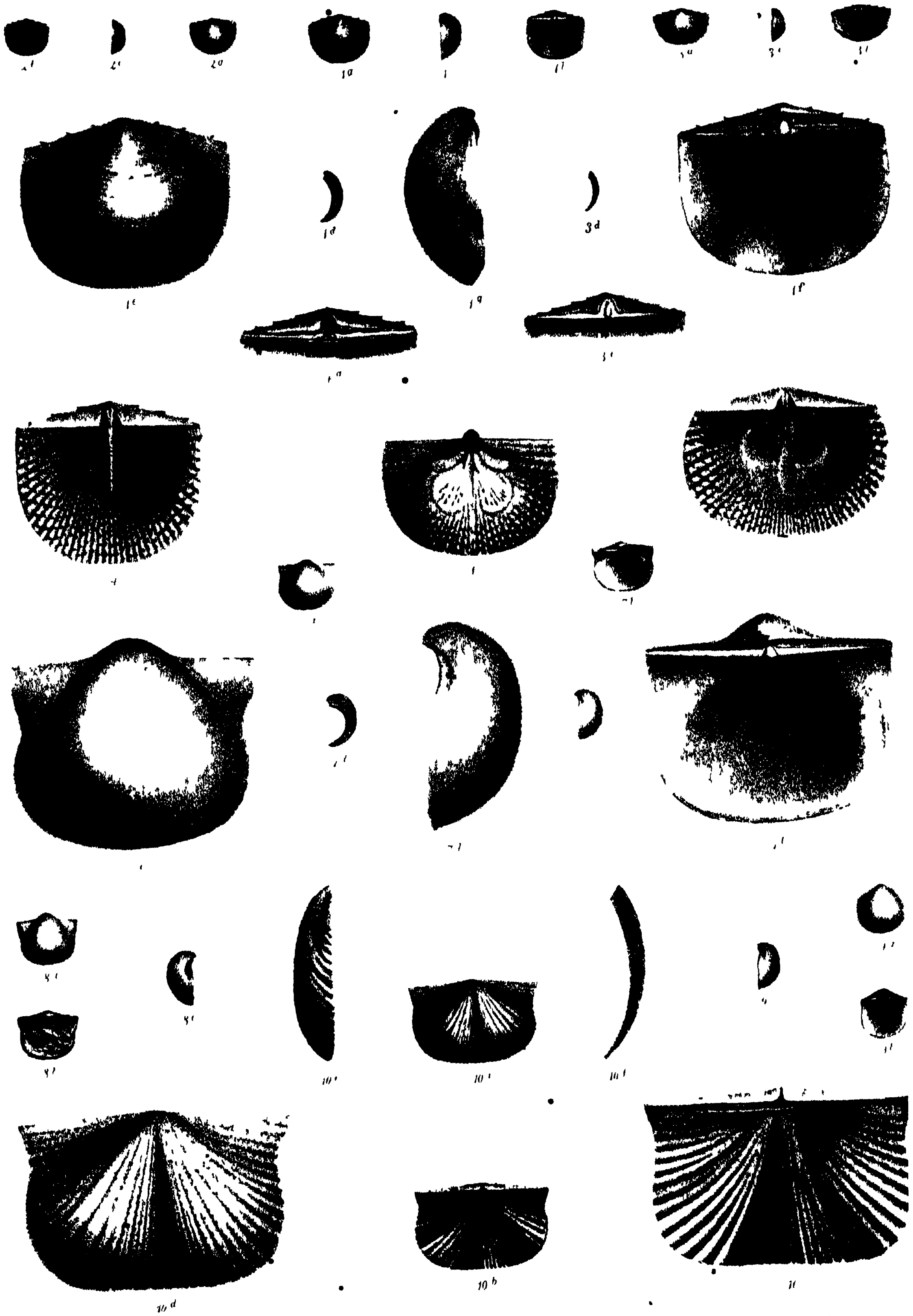

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PLATE LIX.

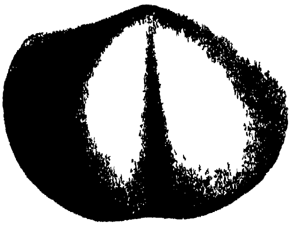
PRODUCTUS-LIMESTONE.

Figures 1, 2. CHONETES BIPARTITA, Waagen, n. sp., p. 624. Two specimens with preserved shell, from the upper Productus-limestone of Khund Ghat. Fig. 1*a*, *b*, ventral and lateral views, natural size; 1*c*, *d*, *e*, ventral, dorsal and front views of the ventral valve enlarged, the cardinal teeth have been obliterated by weathering. Fig. 2*a*, internal view of the dorsal valve, natural size: 2*b*, the same view enlarged.

3, 4. CHONETES TRAPEZOIDALIS, Waagen, n. sp., p. 623. Two specimens with preserved shell, from the upper Productus-limestone of Morah. Fig. 3*a*, ventral view, natural size; 3*b*, *c*, *d*, ventral, lateral and front views enlarged. Fig. 4, smaller specimen; 4*a*, ventral view, natural size; 4*b*, the same enlarged.

5. CHONETES AVICULA, Waagen, n. sp., p. 622. Specimens with preserved shell from the upper Productus-limestone of Khura; 5*a*, *b*, ventral and dorsal views, natural size; 5*c*, ventral view; 5*d*, dorsal view; 5*e*, lateral view; 5*f*, front view,—the latter four figures enlarged.

6—8. CHONETES MORAHENSIS, Waagen, n. sp., p. 620. Three specimens with preserved shell, from the upper Productus-limestone of Morah. Fig. 6, largest specimen known to me; 6*a*, *b*, ventral and lateral views, natural size; 6*c*, ventral view; 6*d*, front view; 6*e*, area, the cardinal teeth obliterated by weathering,—these latter three figures enlarged. Figs. 7, 8, two smaller specimens, ventral and lateral views.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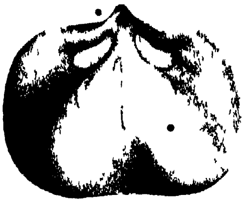
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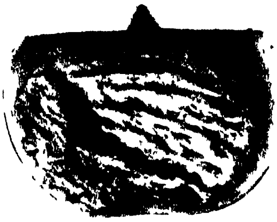
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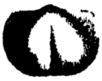
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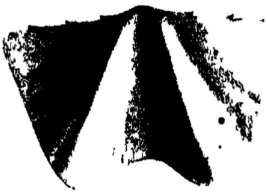
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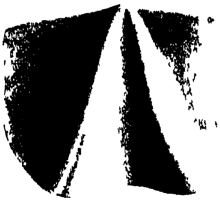
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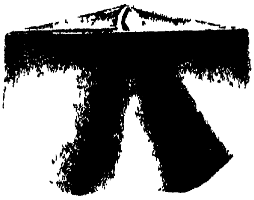
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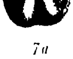
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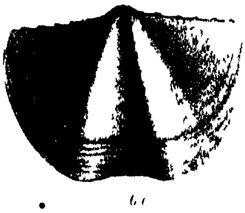
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PLATE LX.

PRODUCTUS-LIMESTONE.

Figures 1—4. CHONETES SQUAMULIFERA, Waagen, n. sp., p. 634. Figs. 1, 2, two specimens with preserved shells, from the *Cephalopoda*-bed of Jabi; 1*a*, ventral view, natural size; 1*b*, ventral view; 1*c*, lateral view; 1*d*, front view; 1*e*, apical view; 1*f*, area of the ventral valve,—the latter five figures enlarged; 2*a*, internal view of the dorsal valve, natural size; 2*b*, the same enlarged. Fig. 3, specimen from the base of the upper Productus-limestone from west of Khura; 3*a*, dorsal view; 3*b*, front view,—both natural size; 3*c*, ventral view; 3*d*, dorsal view; 3*e*, lateral view; 3*f*, front view,—the latter four figures enlarged. Fig. 4, specimen from the middle Productus-limestone of Káfirkot; 4*a*, ventral view, natural size; 4*b*, ventral view; 4*c*, lateral view,—both enlarged.

5, 6. CHONETES DEPLANATA, Waagen, n. sp., p. 637. Two specimens with preserved shell from the middle Productus-limestone of Káfirkot. Fig. 5*a*, *b*, ventral and dorsal views, natural size; 5*c*, ventral view; 5*d*, dorsal view; 5*e*, lateral view, 5*f*, apical view; 5*g*, front view,—the latter five figures enlarged. Fig. 6, larger specimen; 6*a*, ventral view, natural size; 6*b*, the same enlarged.

7. CHONETES ÆQUICOSTA, Waagen, n. sp., p. 639. Specimen with preserved shell from the *Cephalopoda*-bed of the upper Productus-limestone of Jabi; 7*a*, ventral view, natural size; 7*b*, ventral view; 7*c*, lateral view; 7*d*, front view; 7*e*, apical view,—these latter four figures enlarged.

SALT-RANGE FOSSILS

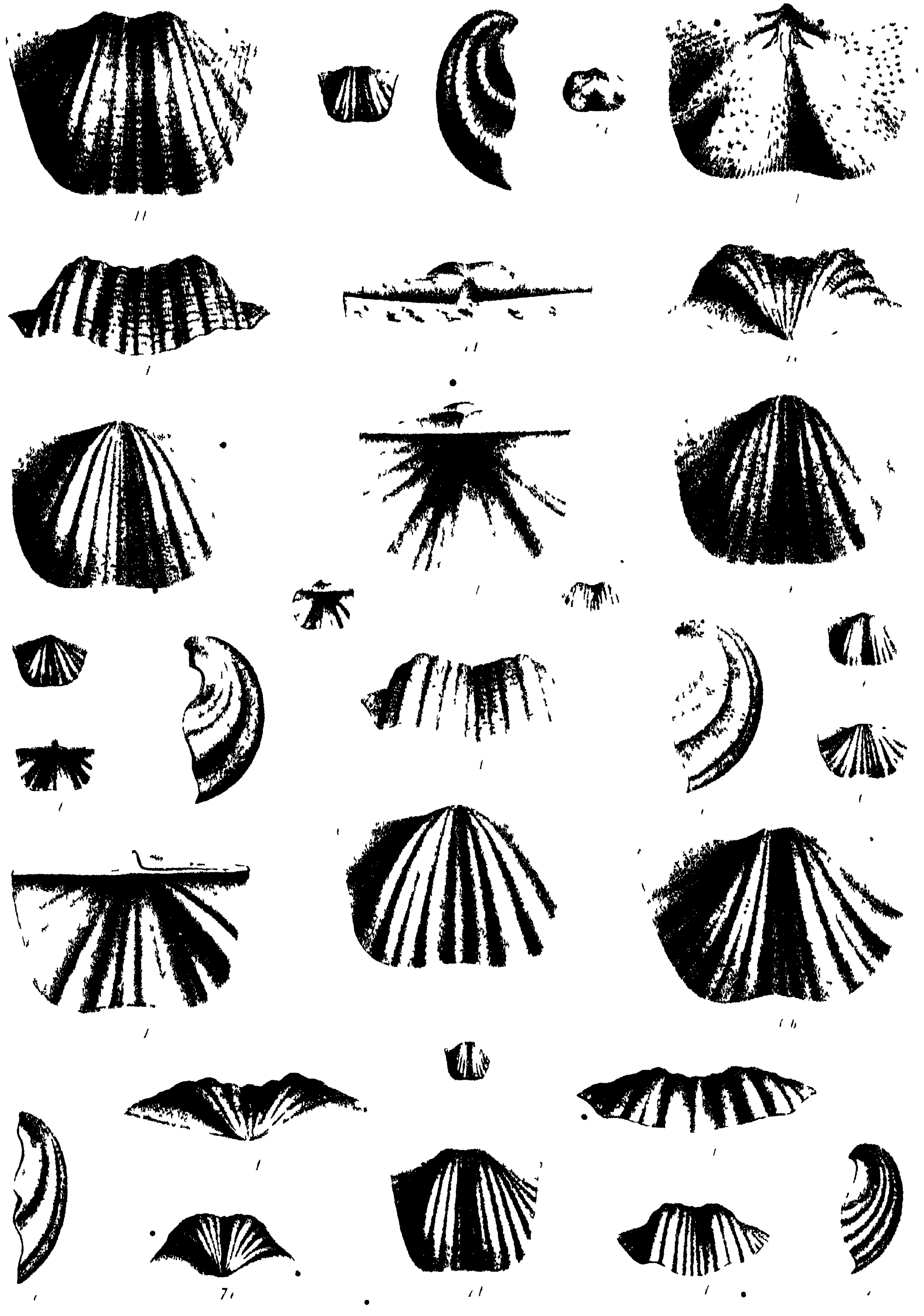


PLATE LXI.

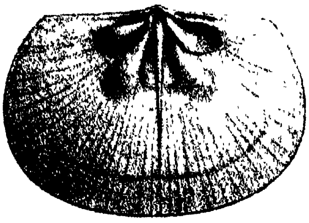
PRODUCTUS-LIMESTONE.

Figures 1—3. CHONETES SQUAMA, Waagen, n. sp., p. 626. *Three specimens with preserved shell,* probably from the middle Productus-limestone of Katwáhi; *1a, dorsal view, natural size; 1b, the same* enlarged; 1c, longitudinal section, *enlarged. Fig. 2,* internal view of the dorsal valve of another specimen, enlarged. *Fig. 3,* internal view of the ventral valve of a third specimen, *enlarged.*

4. *CHONETES DICHOTOMA, Waagen, n. sp., p. 633.* Specimen with preserved shell, *probably from the middle Productus-limestone of Katwáhi; 4a, ventral view; 4b, dorsal view; 4c, lateral view; 4d, apical view,—all four natural size; 4d, ventral view; 4e, dorsal view,—the two latter figures enlarged.*

5. CHONETES SEMIOVALIS, Waagen, n. sp., p. 632. *Specimen with preserved shell* from the middle Productus-limestone of Morah; *5a,* ventral view; *5b,* front view; *5c,* lateral view,—all three natural size; *5d,* ventral view, enlarged.

6, 7. CHONETES GRANDICOSTA, Waagen, n. sp., p. 638. Two specimens from the *Cephalopoda*-bed of the upper Productus-limestone of Jabi: *6a,* ventral view, natural size; *6b,* the same enlarged; *6c,* lateral view; *6d,* front view; *6e,* apical view,—all these figures enlarged; *6f,* apical view, natural size. Fig. 7, other specimen; *7a,* ventral view, natural size; *7b,* the same enlarged; *7c,* lateral view; *7d,* apical view,—both enlarged; *7e,* apical view, natural size.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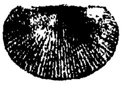
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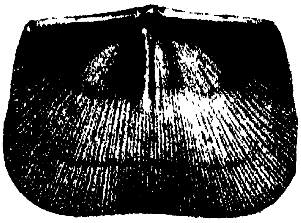
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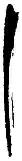
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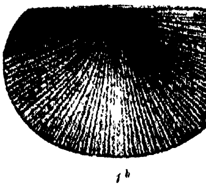
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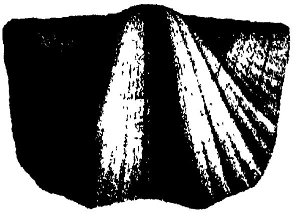
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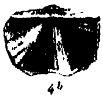
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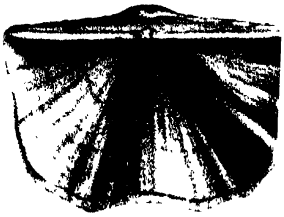
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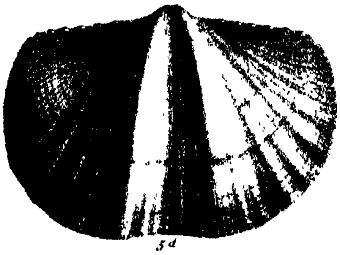
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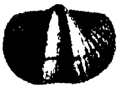
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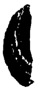
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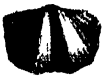
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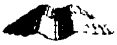
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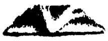
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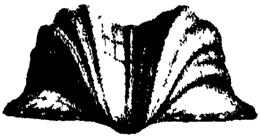
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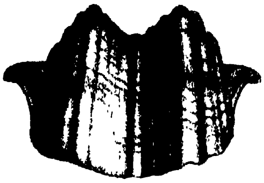
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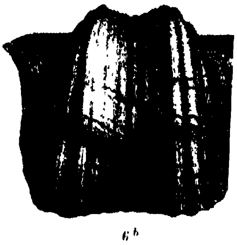
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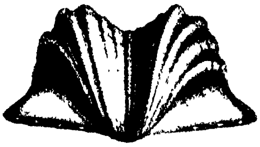
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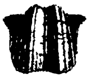
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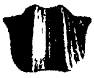
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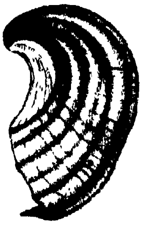
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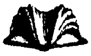
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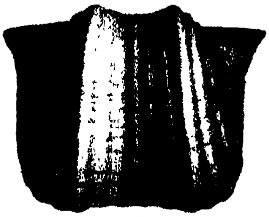
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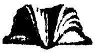
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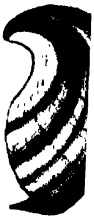
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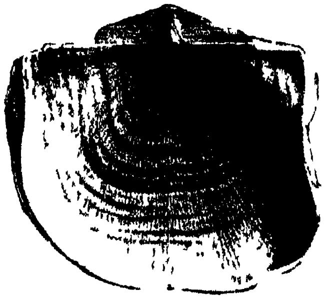
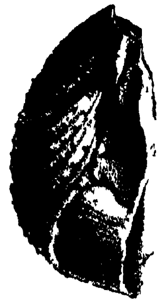
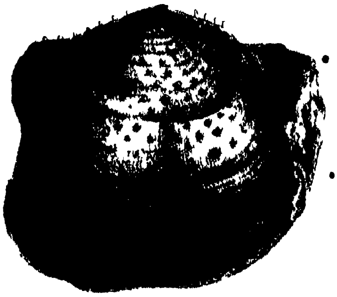
PLATE LXII.

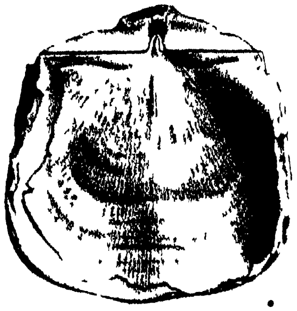
PRODUCTUS-LIMESTONE.

Figures **1—4.** AULOSTEGES MEDLICOTTIANUS, Waagen, *n. sp., p. 663. Figs. 1—2, two specimens with preserved shell from the lower Productus-limestone of Amb; 1a, ventral view; 1b, dorsal view; 1c, lateral view,—all natural size; 1d,* portion of the surface of the lower shell layer enlarged. *Fig.* 2, other specimen; *2a,* ventral view; *2b,* dorsal view; *2c,* lateral view,—all three natural size. Fig. 3, specimen with preserved shell from the lower Productus-limestone of Chidru; *3a,* ventral view; *3b,* dorsal view; *3c,* lateral view,—all three natural size. Fig. 4, dorsal valve from the lower Productus-limestone of Amb; *4a,* internal view, probably showing some malformation; *4b,* apical view; *4c,* outline of the specimen as it probably would be exhibited if no malformation were present









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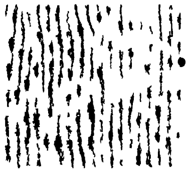

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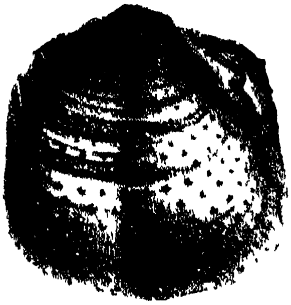

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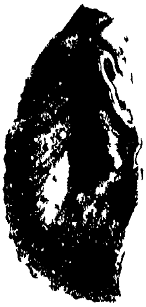

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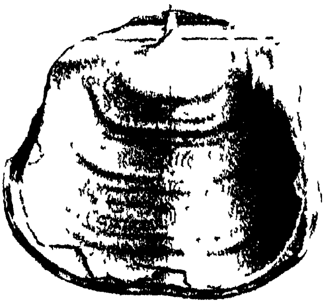

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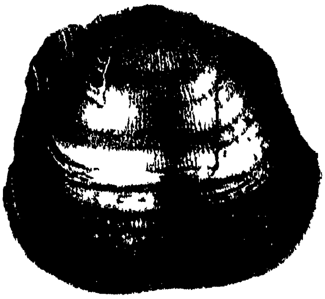

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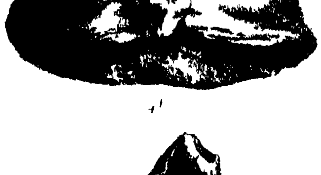

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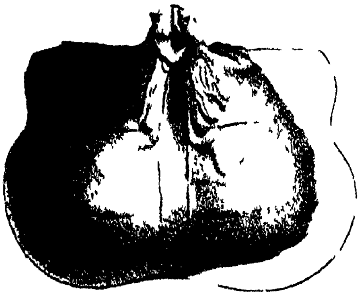

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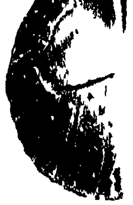

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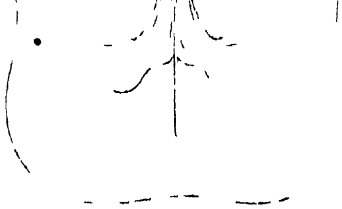

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PLATE LXIII.

PRODUCTUS-LIMESTONE.

1 Aulosteges dalhousi, Davidson, p. 662. Silicified specimen from the upper beds of the middle Productus-limestone from Musakheyl ; 1*a*, ventral view ; 1*b*, dorsal view ; 1*c*, lateral view,—all natural size.

2—6. Strophalosia plicosa, Waagen, n. sp., p. 650. Figs. 2—3, two specimens with partly defaced shell, from the lowest fossiliferous beds of the lower Productus-limestone of the Chittawán ; 2*a*, ventral view ; 2*b*, lateral view ; 2*c*, apical view,—all natural size. Fig. 3, other specimen with the shell-surface partly well preserved ; 3*a*, ventral view ; 3*b*, lateral view ; 3*c*, front view,—all natural size. Fig. 4, dorsal valve much defaced, from the lower Productus-limestone of Khairabad ; 1*a*, internal view ; 4*b*, lateral view. Figs. 5—6, two specimens much defaced, from the lower Productus-limestone at Dokri ; 5*a*, dorsal view ; 5*b*, lateral view ; 5*c*, apical view ; 6, fragmentary specimen showing the spines,—all natural size.

7, 8. Strophalosia costata, Waagen, n. sp., p. 655. Fig. 7, specimen with partly preserved shell, from the lowest fossilferous beds of the lower Productus-limestone of the Amb glen ; 7*a*, ventral gview ; 7*c*, dorsal view ; 7*d*, front view ; 7*f*, lateral view,—all these figures natural size ; 7*b*, dorsal view ; 7*e*, ventral view ; 7*g*, apical view,—these last three figures enlarged. Fig 8, other specimen with partly preserved shell from the *Chonetes*-bed of the lower Productus-limestone below Amb ; 8*a*, ventral view ; 8*b*, front view ; 8*c*, lateral view ; 8*d*, apical view,—all these figures natural size ; 8*e*, ventral view ; 8*f*, apical view,—these latter two figures enlarged.

SALT-RANGE FOSSILS.

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Pl. LXIII.

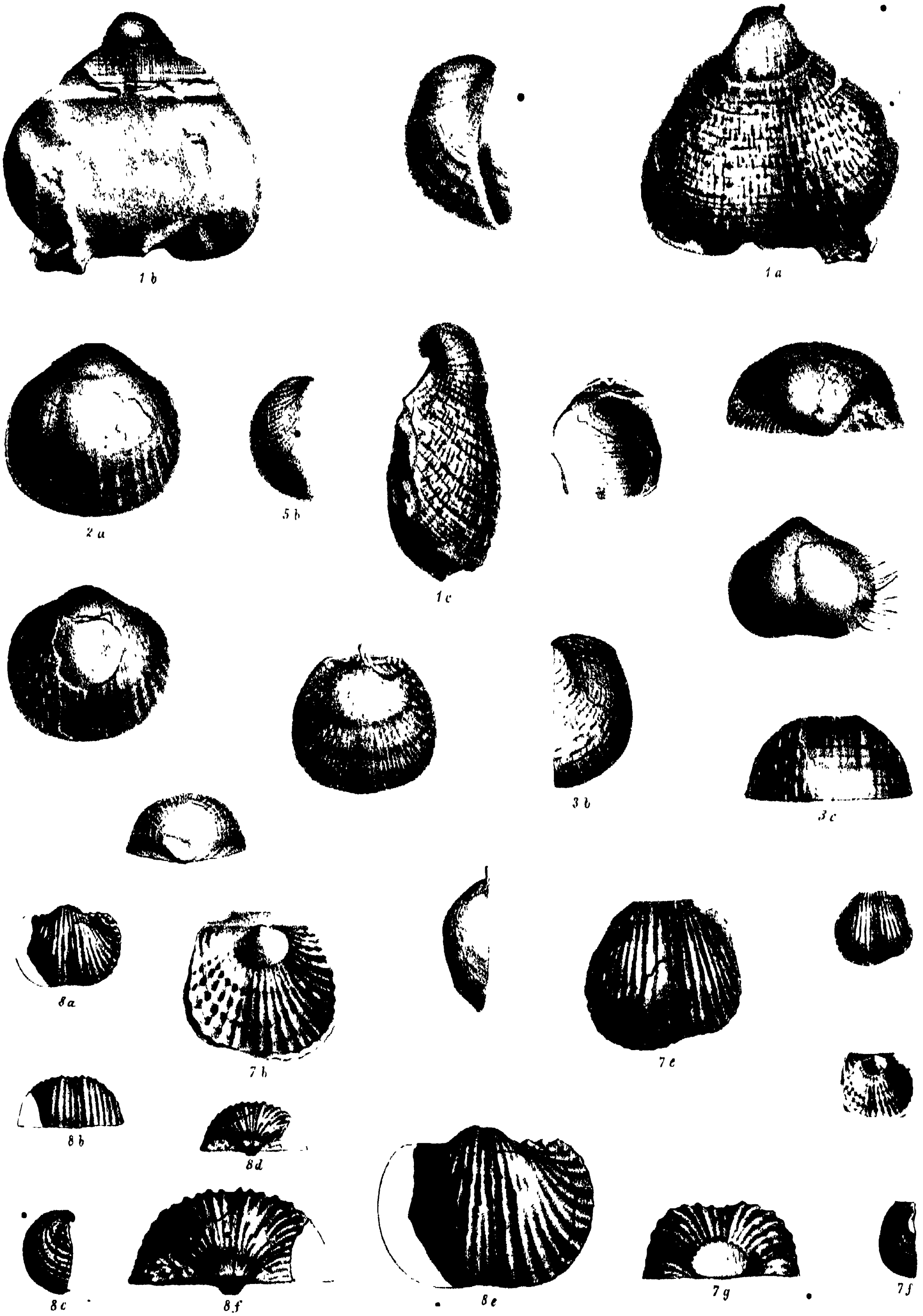

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PLATE LXIV.

PRODUCTUS-LIMESTONE.

Figure 1. STROPHALOSIA COSTATA, Waagen, n. sp., p. 655. Small specimen without shell, from the lowest fossiliferous bed of the lower Productus-limestone of the Amb glen; 1*a*, dorsal view; 1*b*, ventral view; 1*e*, lateral view; 1*f*, front view,—these four figures natural size; 1*c*, dorsal view; 1*d*, ventral view; 1*g*, apical view,—these three figures enlarged.

2—7. STROPHALOSIA TENUISPINA, Waagen, n. sp., p. 654. Six different specimens from the *Chonetes*-bed of the lower Productus-limestone of Amb. Fig. 2, specimen with almost entirely preserved shell-surface and partly preserved spines; 2*a*, ventral view; 2*b*, lateral view; 2*c*, front view, natural size. Fig. 3, other specimen, the shell-surface somewhat defaced; 3*a*, ventral view; 3*b*, lateral view; 3*c*, front view, natural size. Figs. 4, 5, internal sides of two dorsal valves; 4*a*, internal view; 4*b*, lateral view; 4*c*, front view, natural size; the same in fig. 5. Fig. 6, other specimen showing the points of insertion of the spines very completely preserved; 6*a*, ventral view; 6*b*, dorsal view; 6*c*, lateral view; 6*d*, front view,—all natural size. Fig. 7, small specimen; 7*a*, ventral view; 7*b*, dorsal view; 7*c*, lateral view; 7*d*, front view, natural size.

8, 9. STROPHALOSIA NODOSA, Waagen, n. sp., p. 652. Two specimens with for the greater part preserved shell-surface, from the *Chonetes*-bed of the lower Productus-limestone of Amb; 8*a*, ventral view; 8*b*, dorsal view, the dorsal valve covered up by rocky matter; 8*c*, lateral view; 8*d*, front view,—all natural size. Fig. 9, somewhat larger specimen; 9*a*, ventral view; 9*b*, lateral view; 9*c*, front view, natural size.

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Pl LXIV

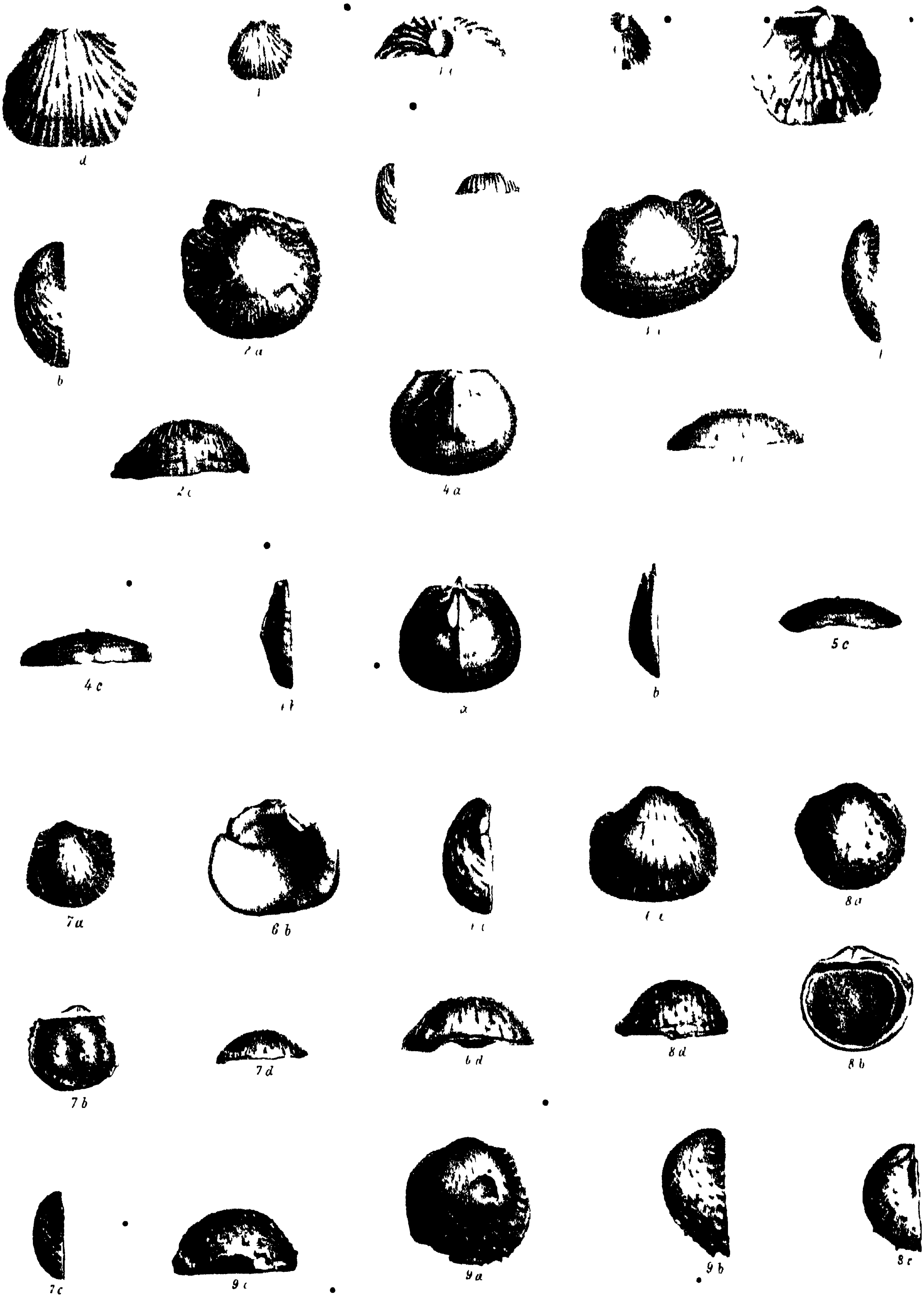

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PLATE LXV.

PRODUCTUS-LIMESTONE.

Figures 1—4. STROPHALOSIA INDICA, Waggen, n. sp., p. 648. Four specimens from the *Cephalopoda*-bed of the upper Productus-limestone of Jabi. Fig. 1, largest specimen known to me with preserved shell; 1*a*, ventral view; 1*b*, the same enlarged; 1*c*, dorsal view; 1*d*, front view; 1*e*, lateral view, natural size. Fig. 2, smaller specimen with preserved shell; 2*a*, ventral view; 2*b*, dorsal view; 2*c*, lateral view; 2*d*, front view,—all natural size. Fig. 3, internal cast of a middle-sized specimen; 3*a*, ventral view; 3*b*, dorsal view; 3*c*, lateral view; 3*d*, front view,—all natural size. Fig. 4, dorsal valve of a small specimen; 4*a*, internal view, natural size; 4*b*, the same enlarged, the brachial ridges are not visible; 4*c*, lateral view, natural size.

5. STROPHALOSIA EXCAVATA, Geinitz, p. 642. Specimen with partly preserved shell from the top-beds of the middle Productus-limestone of Khura; 5*a*, ventral view, natural size; 5*b*, the same enlarged; 5*c*, front view; 5*d*, lateral view, natural size.

6—9. STROPHALOSIA RARISPINA, Waagen, n. sp., p. 645. Figs. 6, 7, two specimens from the middle Productus-limestone on the road between Vurcha and Uchâli. Fig. 6, specimen with partly preserved shell; 6*a*, ventral view, natural size; 6*b*, the same enlarged; 6*c*, lateral view; 6*d*, front view, natural size. Fig. 7, specimen with entirely preserved shell; 7*a*, ventral view; 7*b*, lateral view; 7*c*, front view, natural size. Figs. 8, 9, two specimens from the middle Productus-limestone of Káfirkot; 8*a*, dorsal valve, internal view, natural size; 8*b*, the same enlarged; 8*c*, lateral view, natural size. Fig. 9, specimen with partly preserved shell; 9*a*, dorsal view; 9*b*, lateral view; 9*c*, front view.

SALT-RANGE FOSSILS

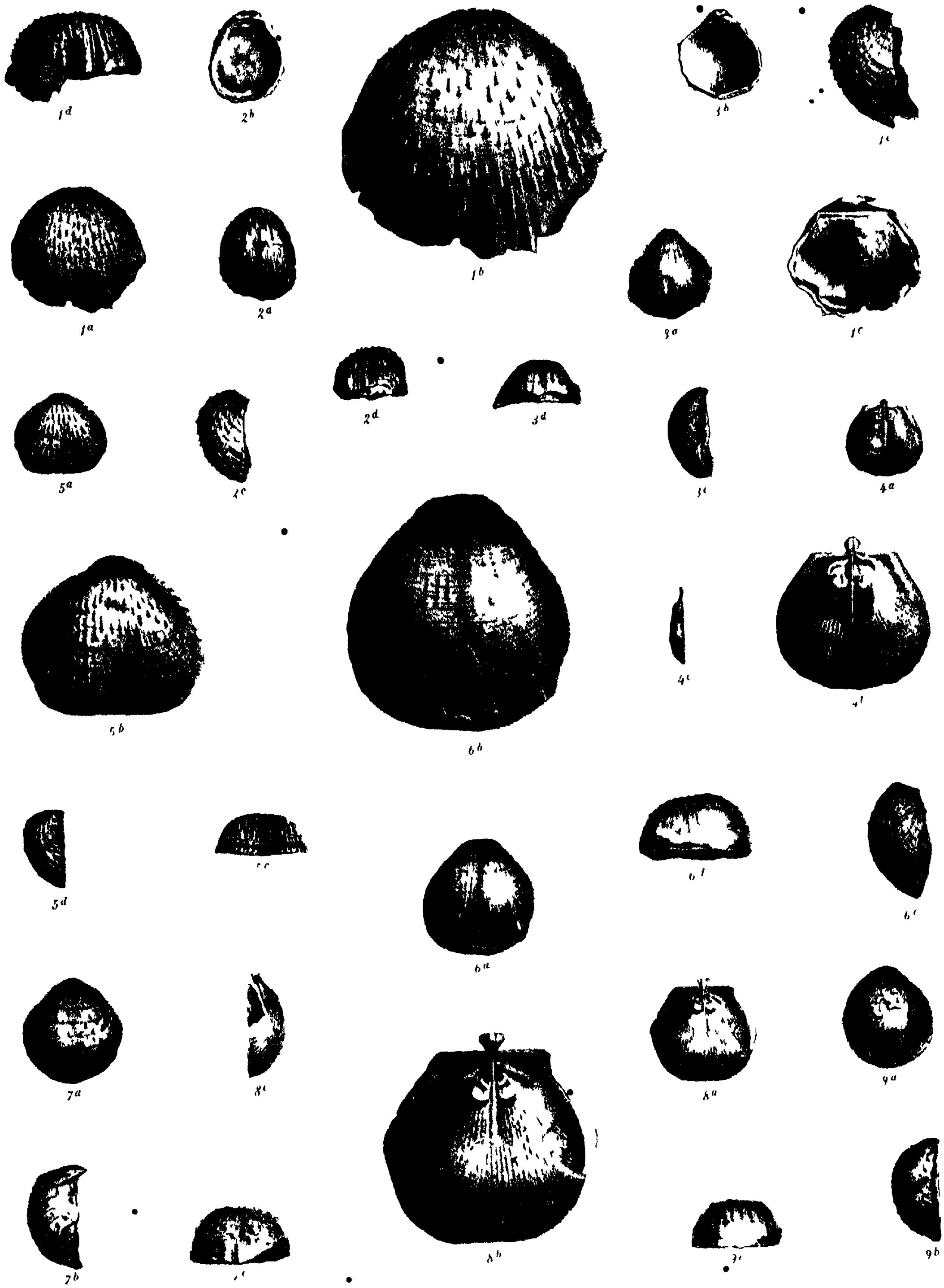

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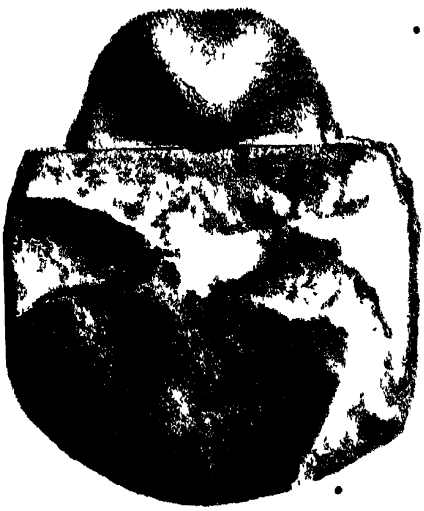
PLATE LXVI.

PRODUCTUS-LIMESTONE.

Figures 1—2. Productus lineatus, Waagen, n. sp., p. 673. Fig. 1, largest specimen known to me, the substance of the shell silicified, and thus the points of insertion of spines obliterated, from the upper region of the middle Productus-limestone of Musakheyl; 1*a*, ventral view; 1*b*, dorsal view; 1*c*, lateral view, natural size. Fig. 2, specimen with preserved shell from the upper Productus-limestone of Khund Ghât; 2*a*, ventral view; 2*b*, dorsal view; 2*c*, lateral view; 2*d*, front view, natural size.

3. Productus cora, Orbigny, p. 677 (=*Prod. prattenianus*, Norw.). Specimen with preserved shell from the *Cephalopoda*-bed of the upper Productus-limestone of Jabi, lateral view. (For other figures, see Pl. LXVII, fig 1.)

SALT-RANGE FOSSILS



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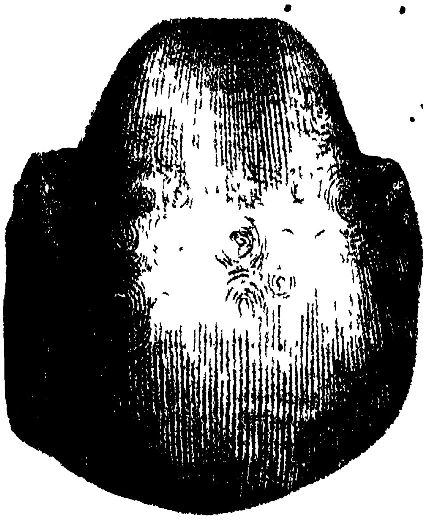

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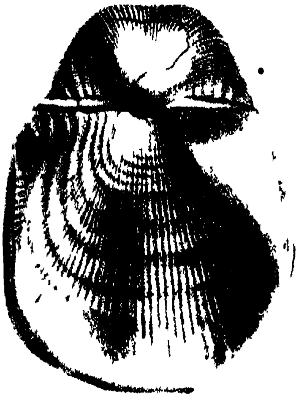

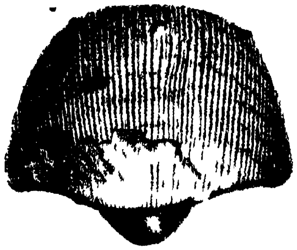

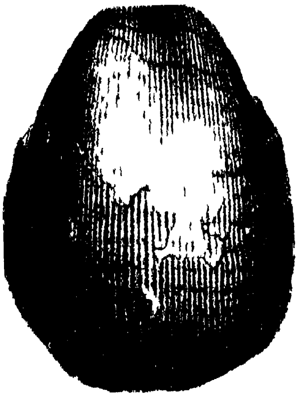

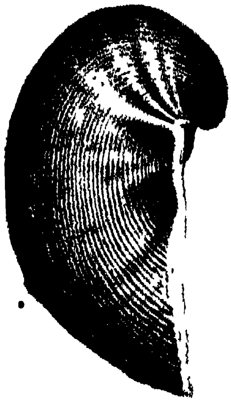

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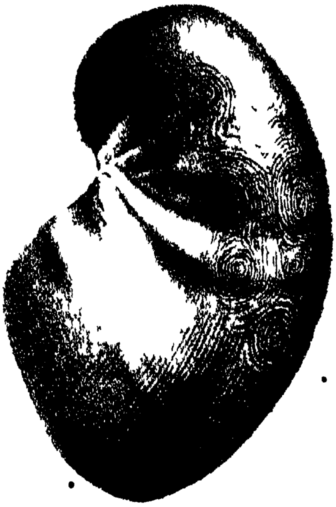

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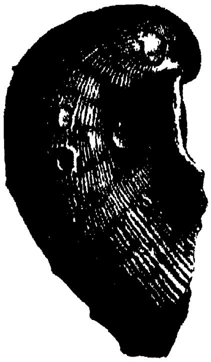

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PLATE LXVII.

PRODUCTUS-LIMESTONE.

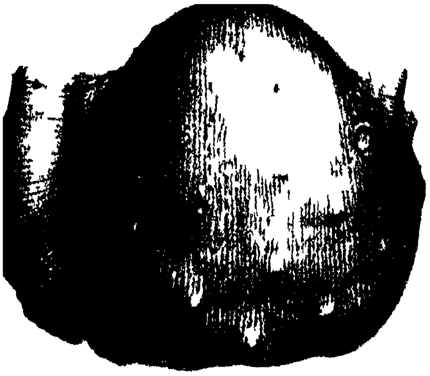
Figures 1—2. PRODUCTUS CORA, Orbigny (=*Prod. prattenianus,* Norw.), p. 677. Two specimens with preserved shell from the *Cephalopoda*-bed of the upper Productus-limestone of Jabi; 1*a,* ventral view; 1*b,* dorsal view; 1*c,* front view. Fig. 2, young specimen; 2*a,* ventral view; 2*b,* lateral view, natural size. (See also preceding Plate.)

3. PRODUCTUS LINEATUS, Waagen, n. sp., p. 673. Impression of a dorsal valve from the middle Productus-limestone of Morála. (See also preceding Plate.)

4—5. PRODUCTUS SUBCOSTATUS, Waagen, n. sp., p. 685. Two full-grown specimens with entirely preserved shell from the middle Productus-limestone of Káfir-kot; 4*a,* ventral view; 4*b,* dorsal view; 4*c,* lateral view; 4*d,* apical view,—all natural size. Fig. 5, other specimen; 5*a,* ventral view; 5*b,* dorsal view; 5*c,* lateral view,—all natural size.

6. PRODUCTUS SPIRALIS, Waagen, n. sp., p. 681. Specimen with preserved shell from the lower Productus-limestone of Chidru; 6*a,* apical view; 6*b,* lateral view,—both natural size. (For further figures of the same specimen, see next Plate.)

SALT-RANGE FOSSILS



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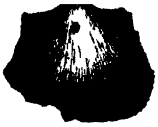

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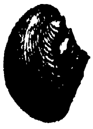

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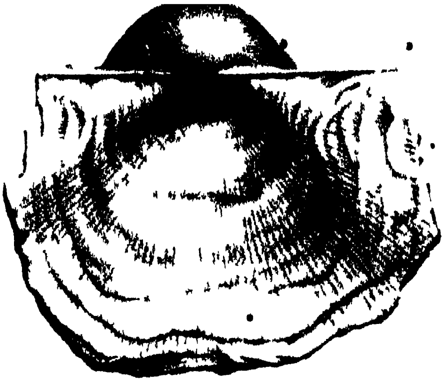

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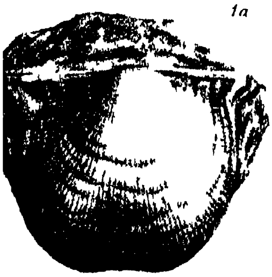

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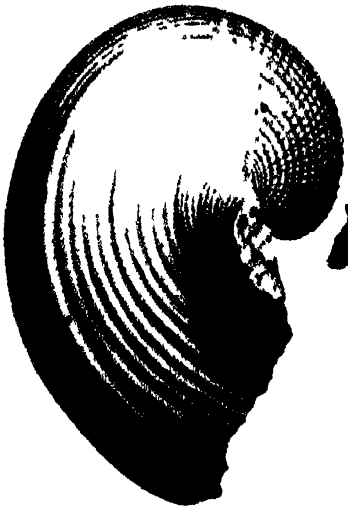

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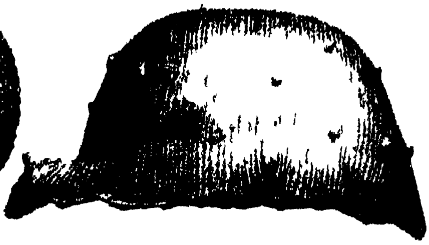

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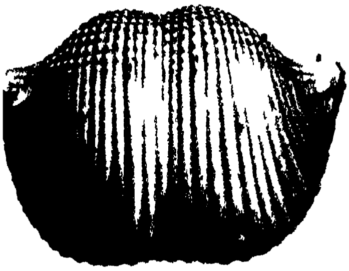

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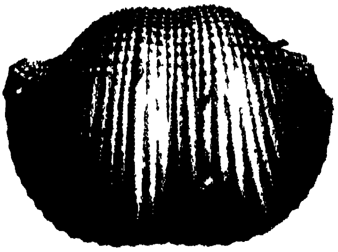

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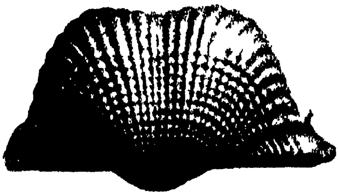

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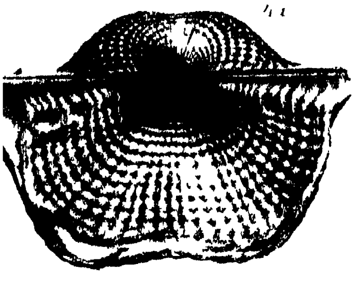

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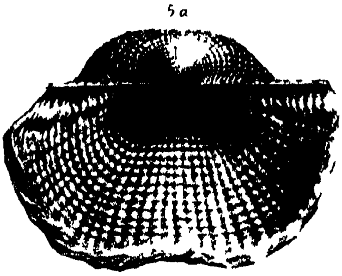

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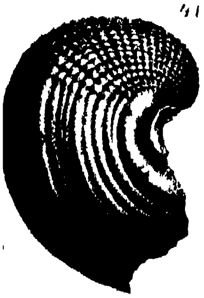

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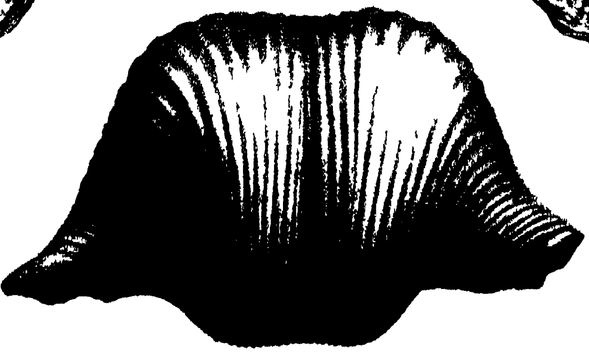

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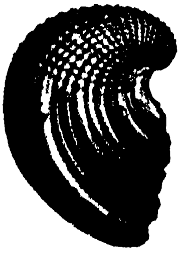

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PLATE LXVIII.

PRODUCTUS-LIMESTONE.

Figure 1. Rock-*Specimen from the middle Productus-limestone of north of Káfirkot to show the association of different species. The species represented are—*

Spirifer musakheylensis, Davids.
Streptorhynchus pectiniformis, Davids.
Strophalosia rarispina, Waagen.
Productus subcostatus, Waagen.
„ abichi, Waagen.
Marginifera typica, Waagen.
Richthofenia lawrenciana, Kon., fragment of the shell.
Fragments of *Crinoid* stems.

2. Productus subcostatus, Waagen, n. sp., p. 685. Specimen with much defaced shell and broken off wings, from the upper Productus-limestone of Nanga; 2, ventral view; 2*a*, lateral view; 2*b*, dorsal view, natural size.

3. Productus spiralis, Waagen, n. sp., p. 681. Specimen with preserved shell somewhat defaced, from the lower Productus-limestone of Chidru; 3, ventral view; 3*a*, dorsal view. (For further figures of the same specimen, see preceding Plate.)

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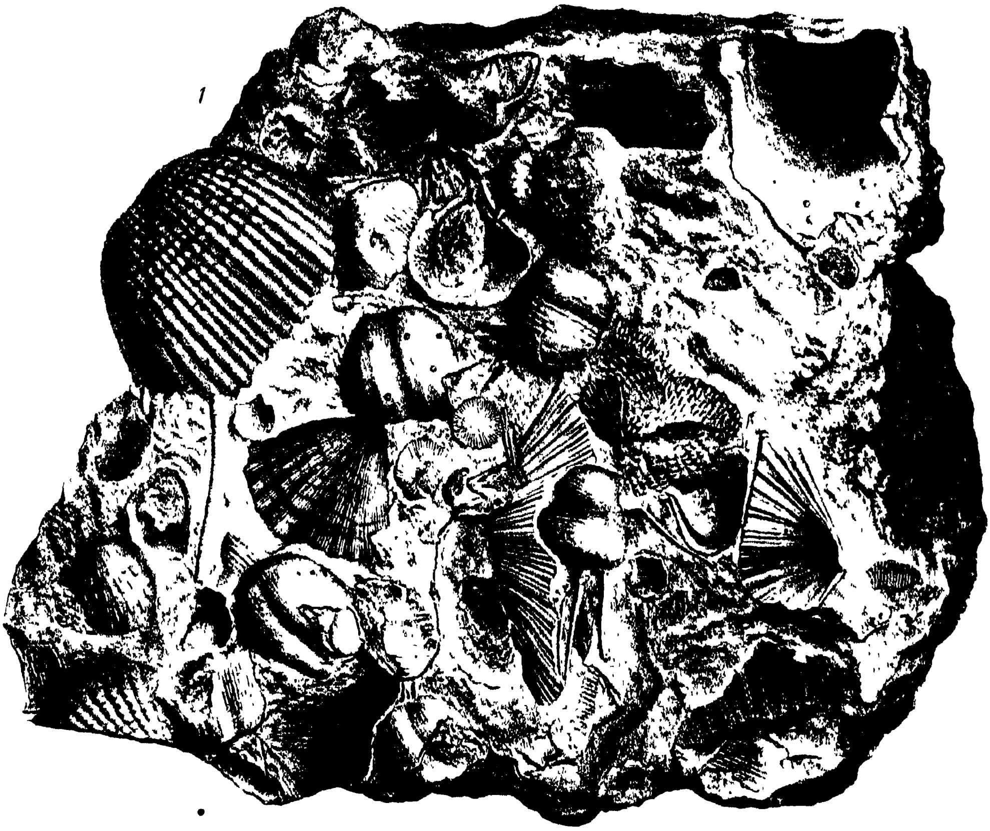

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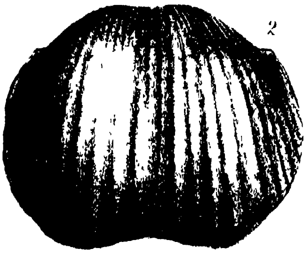

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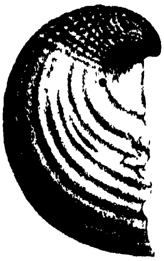

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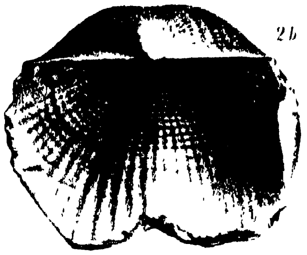

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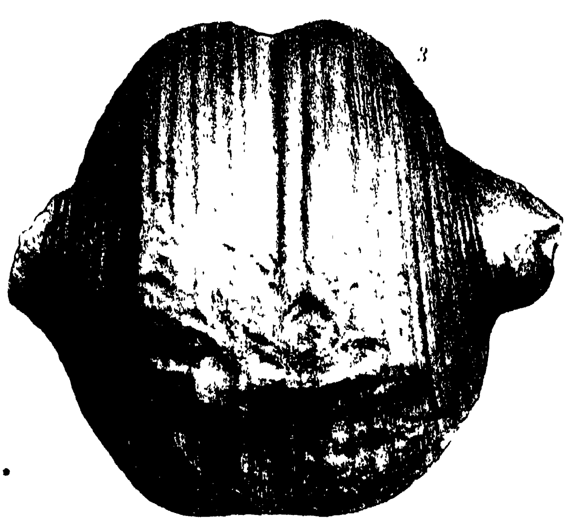

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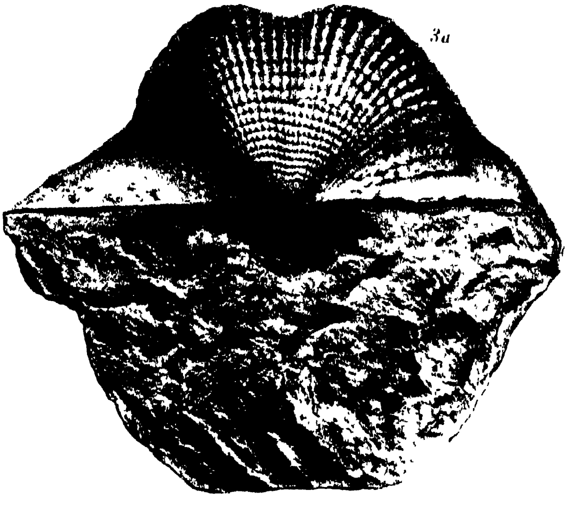


A Swoboda del et lith

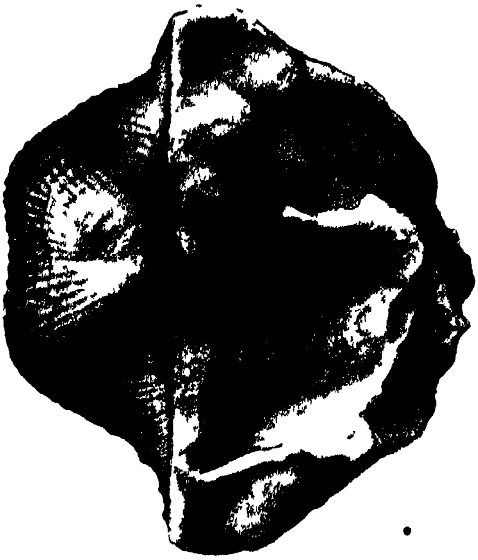
PLATE LXIX.

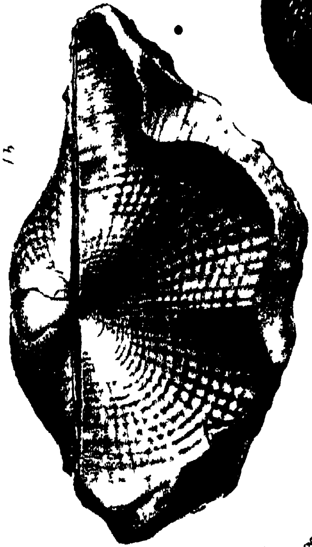
PRODUCTUS-LIMESTONE.

Figures 1—3. **Productus spiralis**, Waagen, n. sp , p. 681. Figs. 1—2, two specimens from the lower Productus-limestone of Swás. Fig. 1, specimen with entirely preserved shell; 1*a*, ventral view; 1*b*, dorsal view; 1*c*, lateral view. Fig. 2, dorsal valve of another specimen; 2*a*, internal view, the brachial ridge to the right broken off; 2*b*, lateral view,—all natural size. Fig. 3, fragmentary specimen from the *Chonetes*-bed of the lower Productus-limestone of Amb, dorsal view, natural size.

4. **Productus subcostatus**, Waagen, n. sp., p. 685. Largest specimen known to me, the wings broken off, from the upper Productus-limestone of Khund Ghât; 4*a*, ventral view; 4*b*, lateral view. (See also figures of the same species on the preceding two Plates.)

SALT-RANGE FOSSILS





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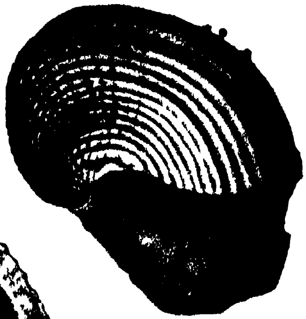

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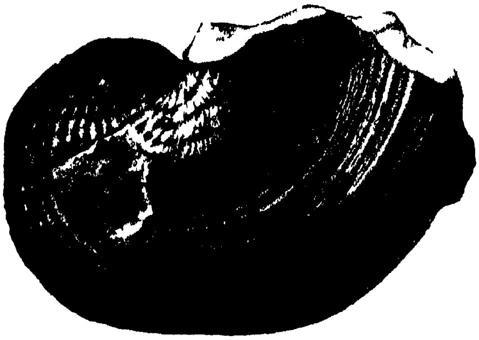

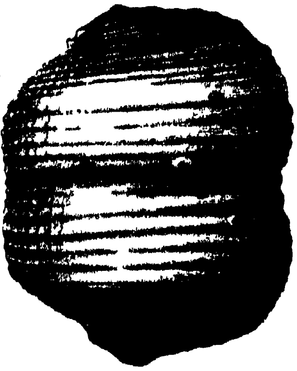

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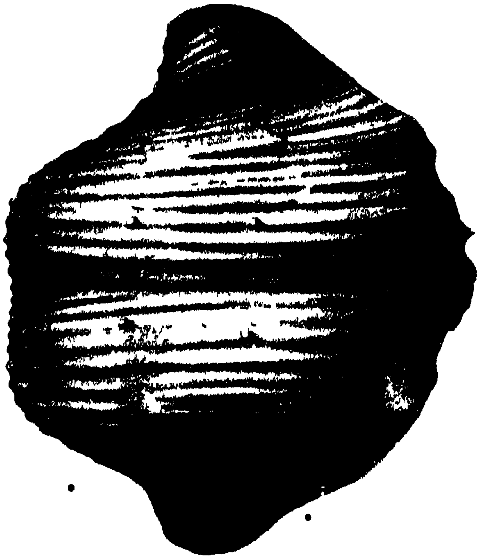

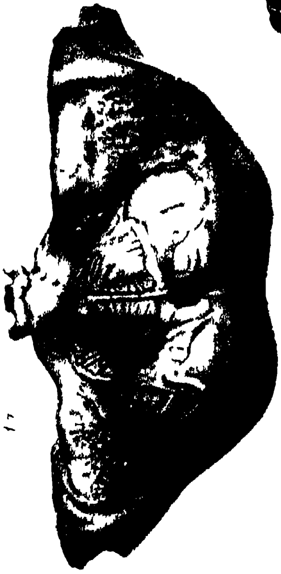

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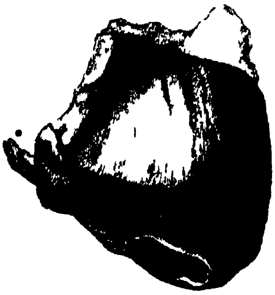

2b

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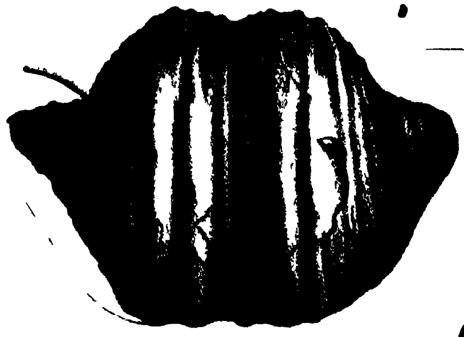
PLATE LXX.

PRODUCTUS-LIMESTONE.

Figures **1—6.** PRODUCTUS INDICUS, Waagen, s. sp., p. 687. Fig. 1, largest specimen known to me, with preserved shell, from the upper Productus-limestone of Khund Ghât; 1*a*, ventral view; 1*b*, dorsal view; 1*c*, lateral view; 1*d*, apical view,—all natural size. Fig. 2, average-sized specimen, with preserved shell, from the *Cephalopoda*-bed of the upper Productus-limestone of Chidru; 2*a*, ventral view; 2*b*, dorsal view; 2*c*, lateral view; 2*d*, apical view,—all natural size. Fig. 3, average-sized specimen, with preserved shell, from the middle Productus-limestone of Káfirkot; 3*a*, ventral view; 3*b*, lateral view, natural size. Fig. 4, young specimen, bivalved, with preserved shell, from the *Cephalopoda*-bed of the upper Productus-limestone of Jabi; 4*a*, ventral view; 4*b*, dorsal view; 4*c*, lateral view,—all natural size. Fig. 5, dorsal valve from the *Cephalopoda*-bed of Jabi; 5*a*, internal view; 5*b*, lateral view; 5*c*, the cardinal process from the lower side,—all these natural size. Fig. 6, dorsal valve from the *Cephalopoda*-bed of Chidru, the cardinal process is broken off; 6*a*, internal view; 6*b*, latetal view,—both natural size.



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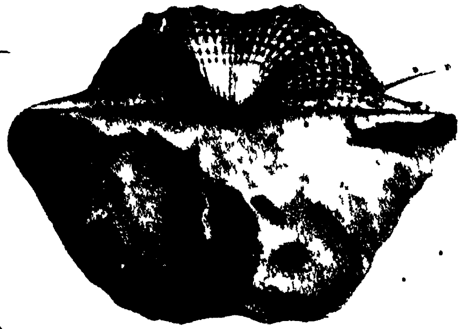

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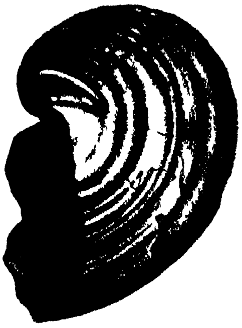

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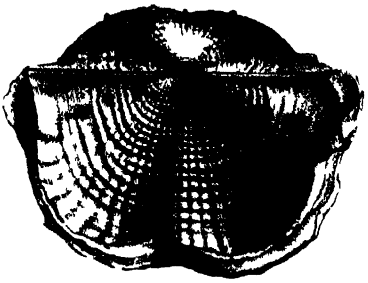

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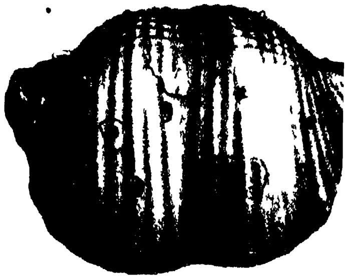

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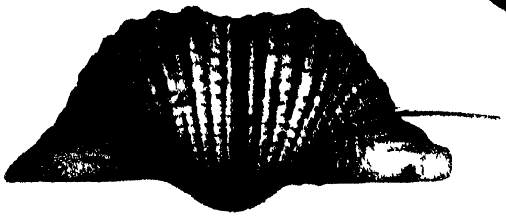

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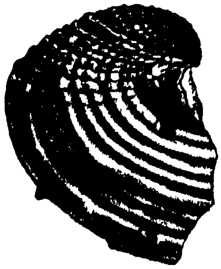

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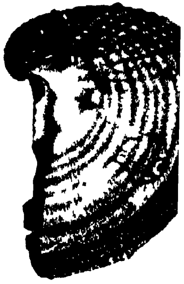

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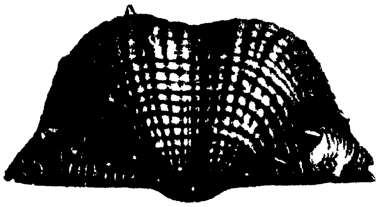

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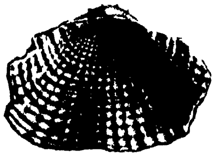

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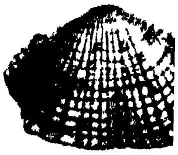

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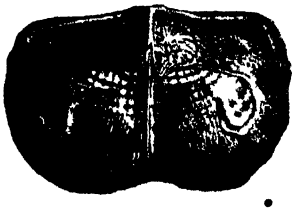

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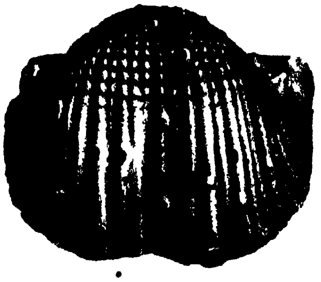

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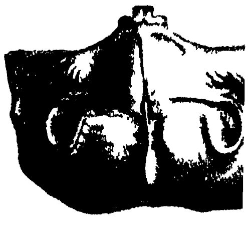

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A. Swoboda del. et lith.

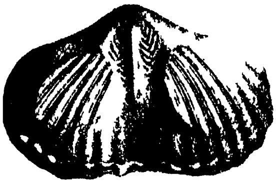
PLATE LXXI.

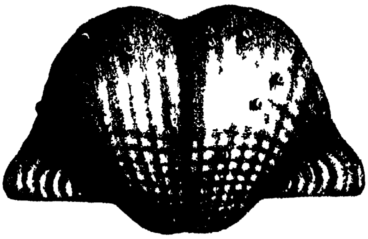
PRODUCTUS-LIMESTONE.

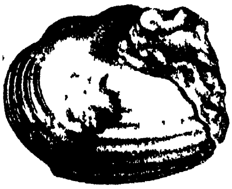
Figure 1. Productus indicus, Waagen, n. sp., p. 687. Partial internal cast of the ventral valve, showing the muscular impressions, from the middle Productus-limestone of the Paniála Bluffs Below Shekh Budín; 1*a*, ventral view; 1*b*, lateral view, both natural size.

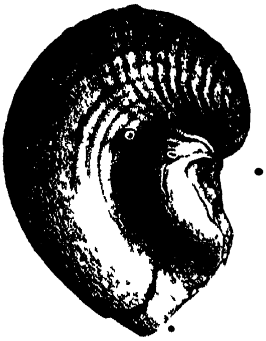
2—3. Productus vishnu, Waagen, n. sp., p. 690. Fig. 2, specimen with preserved shell, the surface layer partly removed by weathering, from the middle Productus-limestone of Khund; 2*a*, ventral view; 2*b*, dorsal view; 2*c*, lateral view; 2*d*, apical view,—all natural size; 2*e*, part of the median layer of the shell enlarged; 2 *f*, part of the surface-layer of the shell enlarged. Fig. 3, specimen partly weathered, from the middle Productus-limestone of Chidru; 3*a*, ventral view; 3*b*, dorsal view; 3*c*, lateral view; 3*d*, apical view,—all natural size.

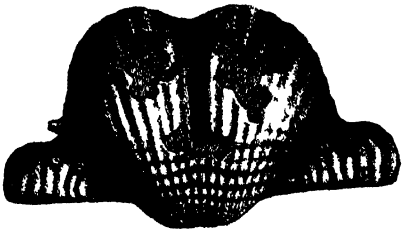
SALT RANGE FOSSILS

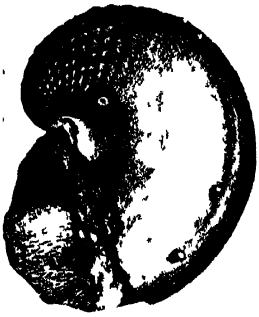


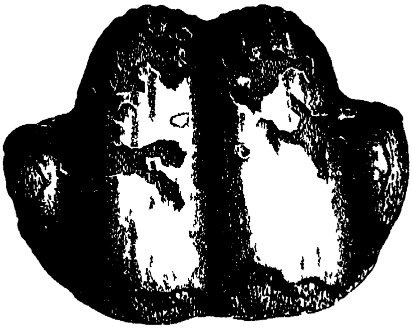


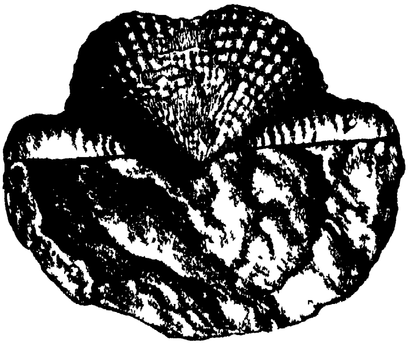


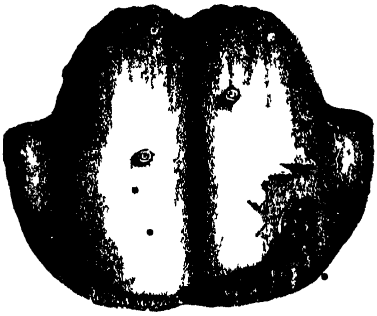


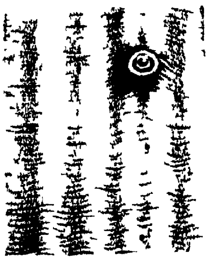












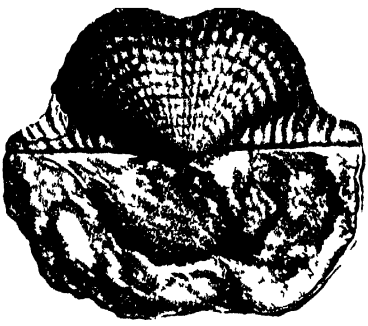
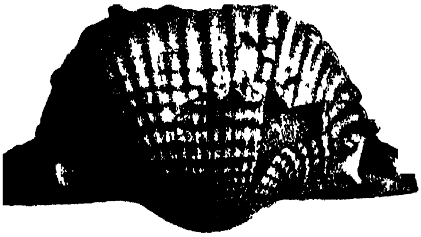


PLATE LXXII.

PRODUCTUS-LIMESTONE.

Figures 1—2. **Productus aratus**, Waagen, n. sp., p. 684. Two specimens with preserved shell, from the *Cephalopoda*-bed of the upper Productus-limestone of Jabi. Fig. 1, largest specimen known to me; 1*a*, ventral view; 1*b*, apical view; 1*c*, lateral view,—all natural size. Fig. 2, smaller specimen; 2*a*, ventral view; 2*b*, apical view; 2*c*, lateral view,—all natural size.

3—7. **Productus gratiosus**, Waagen, n. sp., p. 691. Fig. 3, largest specimen known to me, from the *Cephalopoda*-bed of the upper Productus-limestone of Chidru; 3*a*, ventral view; 3*b*, dorsal view; 3*c*, apical view; 3*d*, front view; 3*e*, lateral view,—all natural size. Fig. 4, average-sized specimen from the middle Productus-limestone of Morah, the wings being broken away; 4*a*, ventral view; 4*b*, dorsal view; 4*c*, apical view; 4*d*, front view; 4*e*, lateral view,—all natural size. Fig. 5, small specimen from the *Cephalopoda*-bed of the upper Productus-limestone of Jabi; 5*a*, ventral view; 5*b*, dorsal view; 5*c*, lateral view; 5*d*, apical view; 5*e*, front view,—all natural size. Fig. 6, young specimen from the middle Productus-limestone of Morah; 6*a*, ventral view; 6*b*, dorsal view; 6*c*, lateral view; 6*d*, apical view,—all natural size. Fig. 7, impressions of the dorsal valve from the same bed and locality as the preceding.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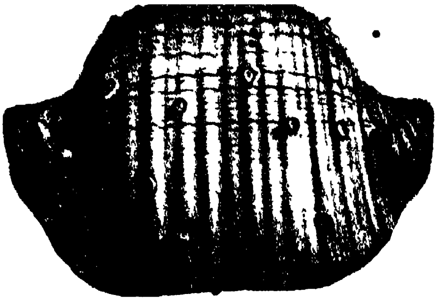
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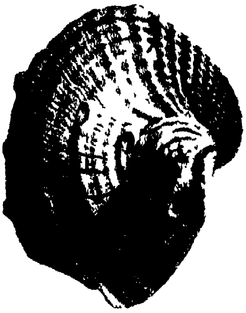
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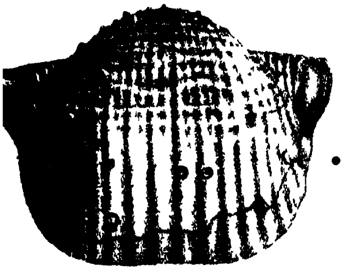
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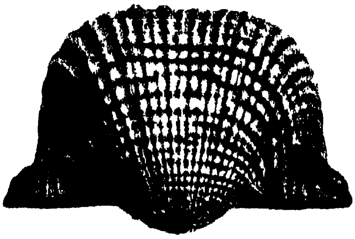
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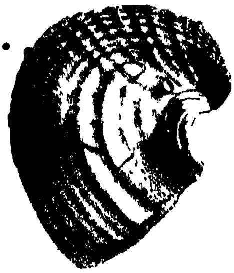
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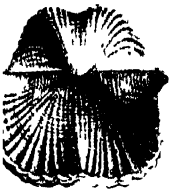

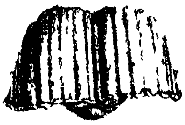

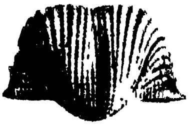
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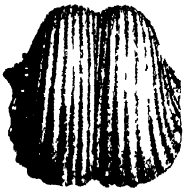
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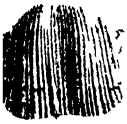

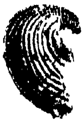
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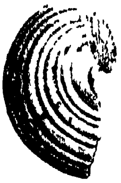

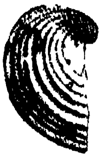
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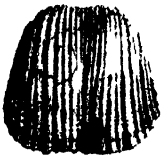

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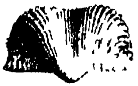
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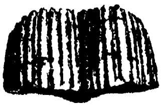
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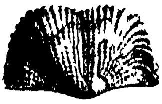
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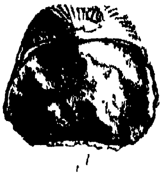
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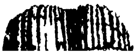

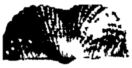
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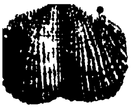
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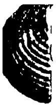

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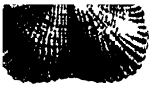
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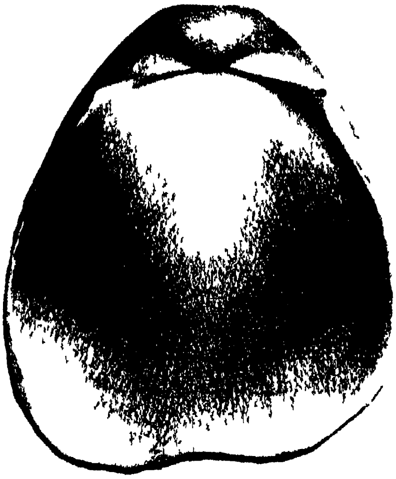
A Swoboda del et lith

PLATE LXXIII.

PRODUCTUS-LIMESTONE

Figures 1—3. PRODUCTUS PURDONI, Davidson, p. 705. Fig. 1, largest specimen known to me, with partly preserved shell, from the upper Productus-limestone of Chidru; 1*a*, ventral view; 1*b*, dorsal view; 1*c*, lateral view; 1*d*, apical view; 1*e*, front view,—all natural size. Fig. 2, specimen with strange radial plications from the upper Productus-limestone of Musakheyl; 2*a*, ventral view; 2*b*, lateral view,—both natural size. Fig. 3, broad and strongly sinuated variety from the topmost beds of the upper Productus-limestone of Bilot, specimen without shell; 3*a*, ventral view; 3*b*, dorsal view; 3*c*, lateral view; 3*d*, front view; 3*e*, apical view,—all natual size.



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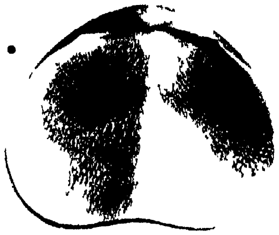

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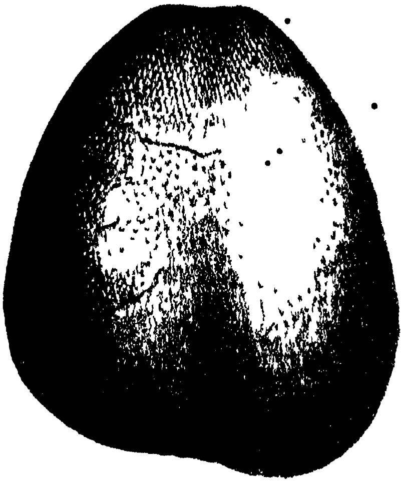

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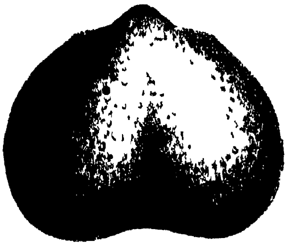

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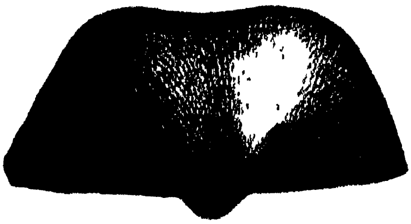

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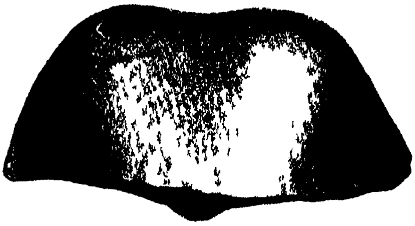

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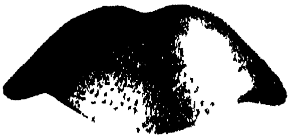
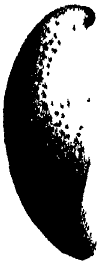
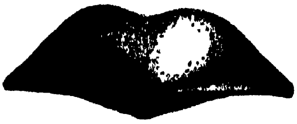
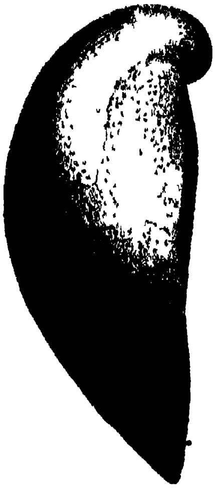
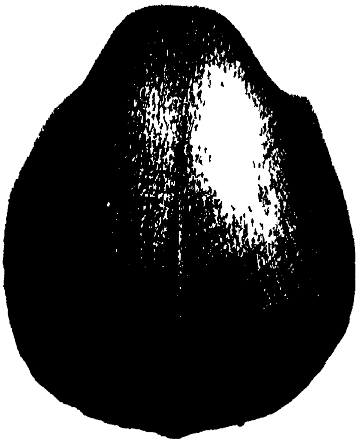
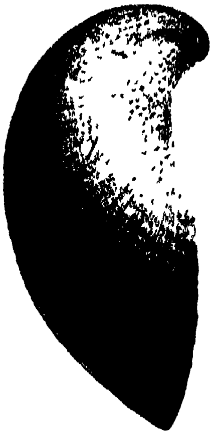












A Swoboda del et lith

Th Bannwarth print

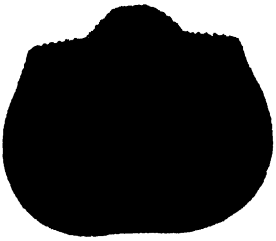
PLATE LXXIV.

PRODUCTUS-LIMESTONE.

Figures 1—7. Productus abichi, Waagen, n. sp., p. 697. Figs. 1—6, specimens from the *Cephalopoda*-bed of the upper Productus-limestone of Jabi. Fig. 1, specimen with its original colour probably preserved, at the same time the largest specimen known to me; 1*a*, ventral view; 1*b*, dorsal view; 1*c*, lateral view; 1*d*, front view. Fig. 2, average-sized specimen; 2*a*, ventral view; 2*b*, dorsal view; 2*c*, lateral view; 2*d*, front view. Fig. 3, specimen with exceptionally well preserved dorsal valve. Fig. 4, small specimen probably with its natural colour. Fig. 5, internal side of a dorsal valve, the very small cardinal process visible, but the other internal characters obliterated. Fig. 6, the internal side of both valves of one and the same specimen; 6*a*, dorsal valve, the internal characters well preserved; 6*b*, ventral valve, to the right below impression of the outer side of the valve. Fig. 7, exceptionally inflated specimen from the *Cephalopoda*-bed of Chidru; 7*a*, ventral view; 7*b*, front view.

8. Productus serialis, Waagen, n. sp., p. 700. Specimen probably preserving its natural colour, from the *Cephalopoda*-bed of the upper Productus-limestone of Jabi; 8*a*, ventral view, the concentric folds too little expressed; 8*b*, dorsal view; 8*c*, lateral view; 8*d*, front view.

SALT-RANGE FOSSILS



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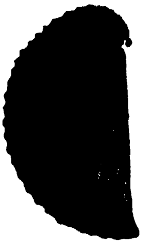

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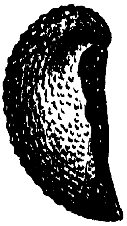

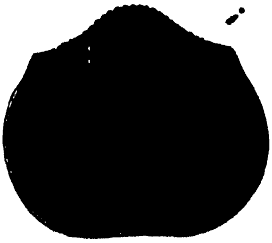

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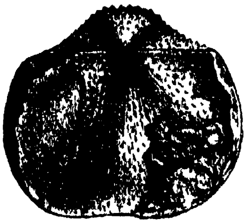

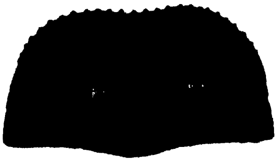

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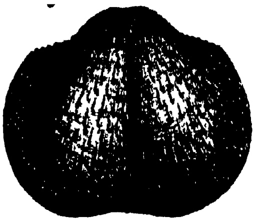

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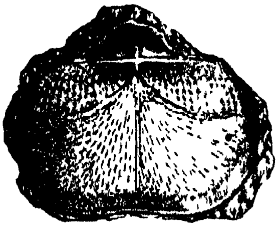

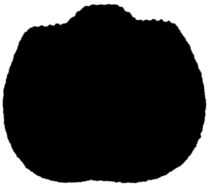

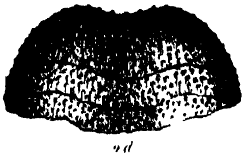

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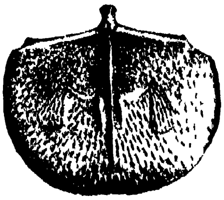

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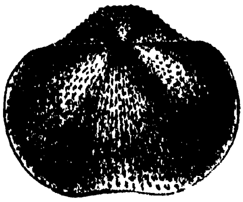

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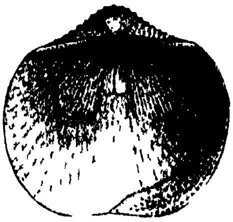

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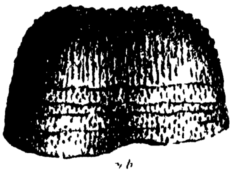

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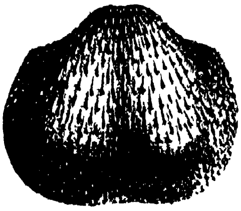

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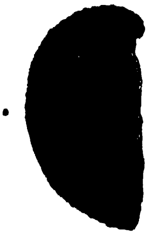

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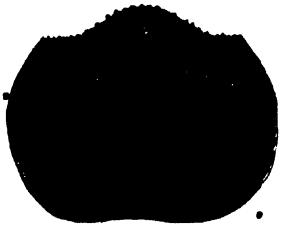

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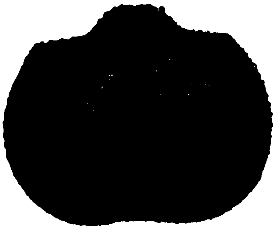
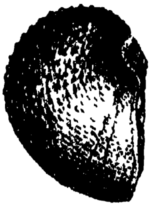




A. Swoboda del et lith

Th. Bannwarth print

PLATE LXXV.

PRODUCTUS-LIMESTONE.

1. PRODUCTUS SERIALIS (?) Waagen, n. sp., p. 700. Dorsal valve from the *Cephalopoda*-bed of the upper Productus-limestone of Jabi.

2. PRODUCTUS SERIALIS, Waagen, n. sp., p. 700. Specimen with preserved shell from the *Cephalopoda*-bed of Jabi; *2a*, ventral view; *2b*, dorsal view; *2c*, lateral view; *2d*, front view,—all natural size.

3, 4. PRODUCTUS CYLINDRICUS, Waagen, n. sp., p. 702. Fig. 3, specimen with preserved shell from the *Cephalopoda*-bed of the upper Productus-limestone of Jabi; *3a*, ventral view; *3b*, dorsal view; *3c*, lateral view; *3d*, front view, natural size. Fig. 4, other specimen with broken margins from the *Cephalopoda*-bed of Jabi: *4a*, ventral view; *4b*, dorsal view; *4c*, lateral view; *4d*, front view, natural size.

5. PRODUCTUS BHALENSIS, Waagen, n. sp., p. 704. Specimen without shell from the lower Productus-limestone of Bhal; *5a*, ventral view; *5b*, lateral view; *5c*, front view, natural size.

6. STROPHALOSIA HORRESCENS, Verneuil, p. 643. Specimen with partly preserved shell from the lowest beds of the middle Productus-limestone of Swás: *6a*, ventral view; *6b*, lateral view; *6c*, front view,—all natural size.

7, 8. MARGINIFERA ECHINATA, Waagen, n. gen. et sp., p. 727. Two specimens from the lower Productus-limestone of Bhal. Fig. 7, inner side of the dorsal valve, the shell preserved only in the frontal region; *7a*, natural size; *7b*, the same lateral view; *7c*, enlarged. Fig. 8, external view of the dorsal valve of another specimen, natural size. (See also Pl. LXXVIII, fig. 1.)

SALT-RANGE FOSSILS

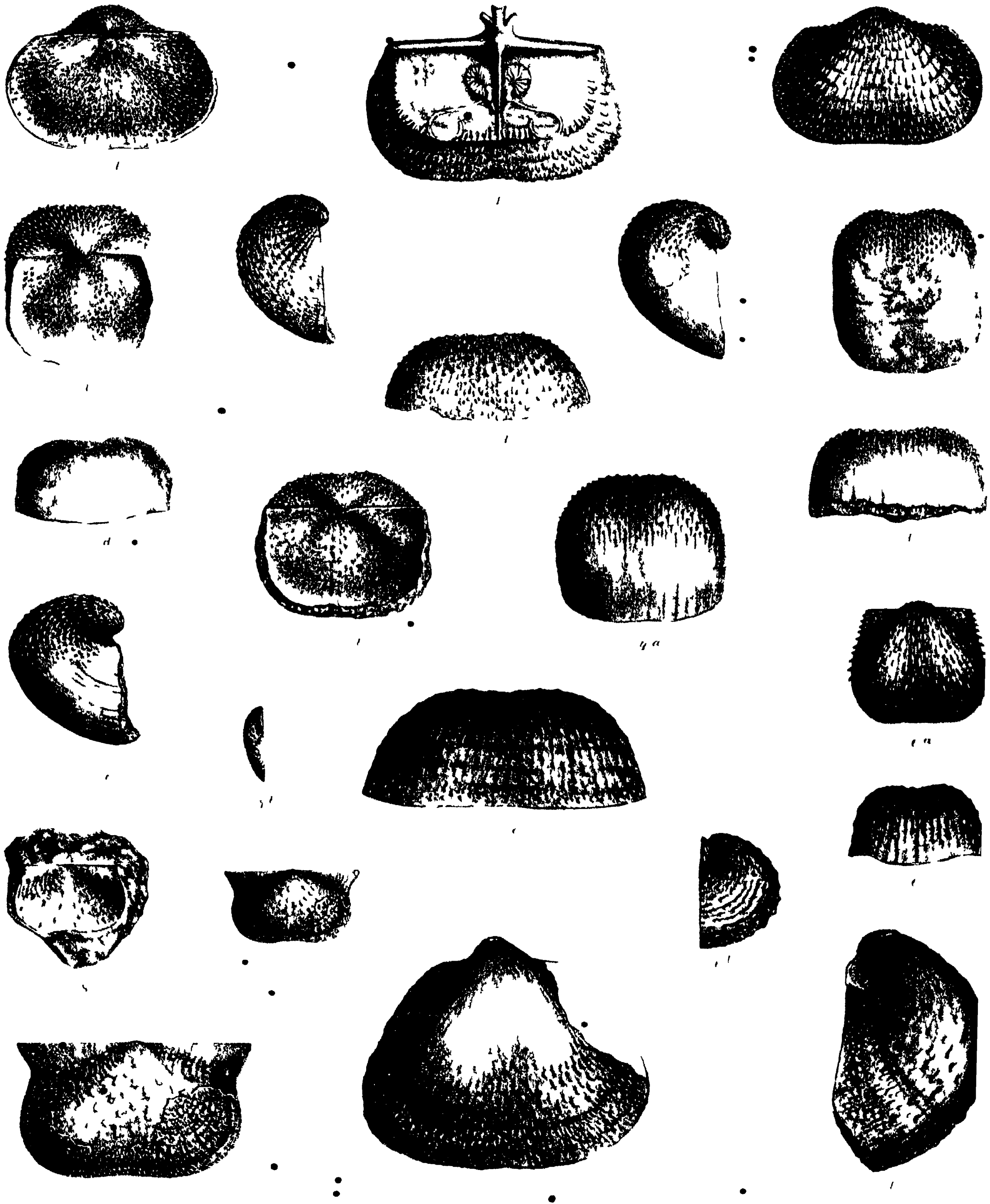


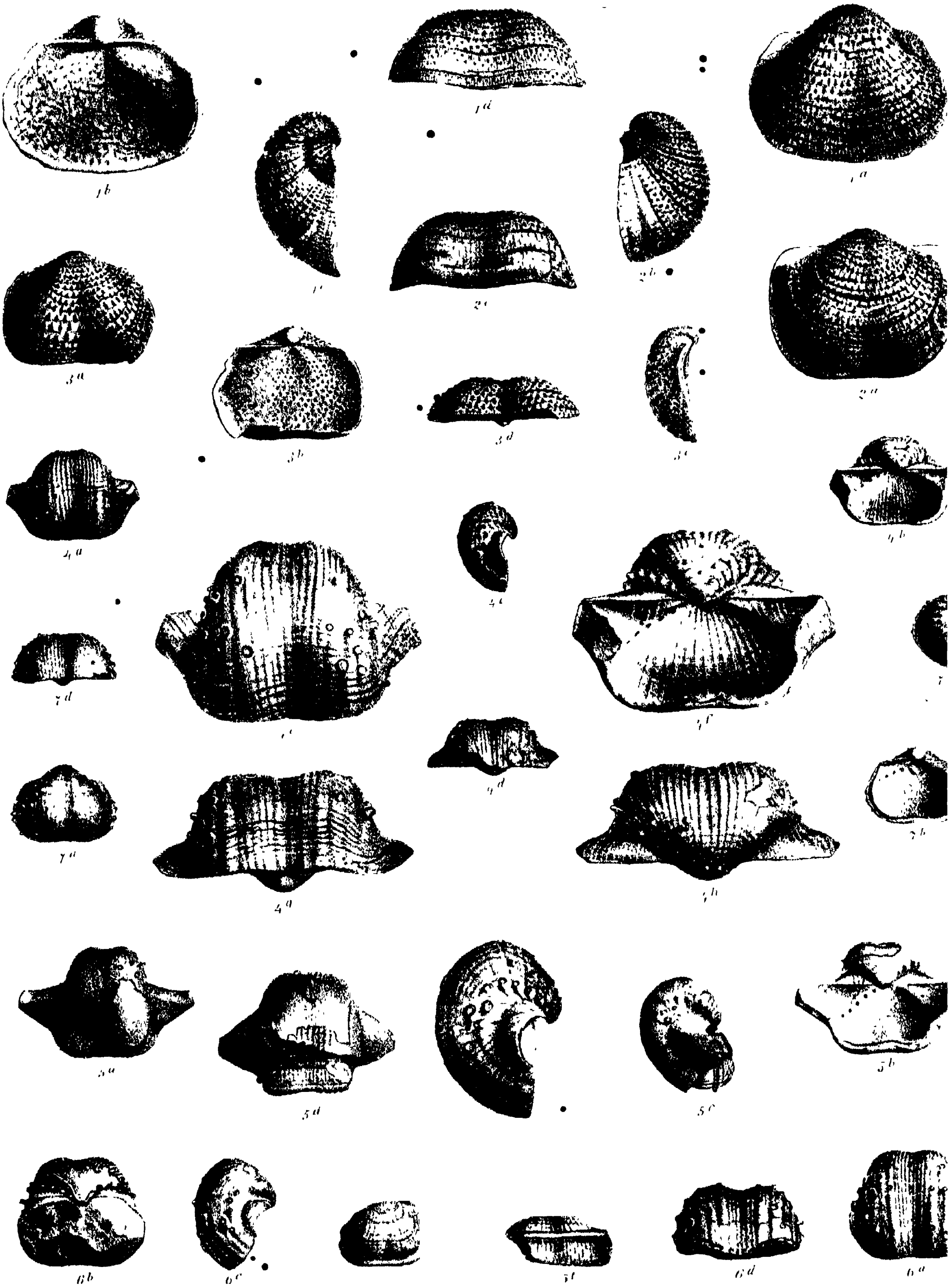
PLATE LXXVI.

PRODUCTUS-LIMESTONE.

Figure 1—3. **Productus humboldti**, Orbigny, p. 695. Fig. 1, specimen with preserved shell, somewhat broken at the wings, from the middle Productus-limestone of Vurcha; 1*a*, ventral view; 1*b*, dorsal view; 1*c*, lateral view; 1*d*, front view. Fig. 2, other specimen from the top-beds of the middle Productus-limestone of Khura, somewhat broken at the wings; 2*a*, ventral view; 2*b*, lateral view; 2*c*, front view. Fig. 3, young specimen from the middle Productus-limestone of Káfirkot, somewhat broken at the margins; 3*a*, ventral view; 3*b*, dorsal view; 3*c*, lateral view; 3*d*, front view,—all natural size.

4—7. **Marginifera typica**, Waagen, n. gen. et sp., p. 717. Fig. 4, average-sized specimen with preserved shell from the middle Productus-limestone at Swás; 4*a*, ventral view; 4*b*, dorsal view; 4*c*, lateral view; 4*d*, front view,—all natural size; 4*e*, ventral view; 4*f*, dorsal view; 4*g*, front view; 4*h*, apical view; 4*i*, lateral view,—these latter five figures enlarged. Fig. 5, largest specimen known to me, the shell only partly preserved, from the *Cephalopoda*-bed of the upper Productus-limestone at Jabi; 5*a*, ventral view; 5*b*, dorsal view, the dorsal valve being only an impression on the rock; 5*c*, lateral view, the dorsal valve projecting below, showing the marginal ridge; 5*d*, front view, the dorsal valve projecting below, showing the marginal ridge; 5*e*, the dorsal valve alone from above, marginal ridge on the front and to the right; 5*f*, the dorsal valve alone from the front, showing the marginal ridge,—all figures natural size. Fig. 6, specimen without wings from the *Cephalopoda*-bed of Chidru; 6*a*, ventral view; 6*b*, dorsal view; 6*c*, lateral view; 6*d*, front view, natural size. Fig. 7, young specimen from the *Cephalopoda*-bed of Jabi; 7*a*, ventral view; 7*b*, dorsal view; 7*c*, lateral view; 7*d*, front view,—all natural size.

SALT-RANGE FOSSILS.



A. Swoboda del. et lith.

Th. Bannwarth

PLATE LXXVII.

PRODUCTUS-LIMESTONE.

Figures 1—4. MARGINIFERA OVALIS, Waagen, n. gen. et sp., p. 723. **Four specimens with preserved shell from the lower Productus-limestone (coaly sandstone) of Amb. Fig. 1, largest specimen known to me, completely preserved; 1*a* ventral view; 1*b*, dorsal view; 1*c*, lateral view; 1*d*, front view,—all natural size; 1*e*, ventral view; 1*f*, dorsal view; 1*g*, lateral view; 1*h*, apical view; 1*i*, front view,—the latter five figures enlarged. Fig. 2, smaller specimen; 2*a*, ventral view; 2*b*, dorsal view; 2*c*, lateral view; 2*d*, front view,—all natural size. Fig. 3, specimen with margins and wings broken off, thus showing the marginal ridges; 3*a*, ventral view; 3*b*, dorsal view; 3*c*, lateral view; 3*d*, apical view,—all natural size. Fig. 4, other specimen showing the marginal ridges, mostly without shell; 4*a*, front view, to the right only some shell remains, below projects the dorsal valve, the marginal ridge closes the distance between dorsal and ventral valves; 4*b*, lateral view, the shell of the ventral valve is preserved, the wing is broken away, and thus the specimen exhibits to view the marginal ridge in this part of the valve,—both natural size.**

5—6. MARGINIFERA ORNATA, Waagen, n. gen. et sp., p. 721. Fig. 5, specimen with entirely preserved shell from the top-bed of the upper Productus-limestone of Amb; 5*a*, ventral view; 5*b*, dorsal view; 5*c*, lateral view; 5*d*, front view,—all natural size; 5*e*, ventral view; 5*f*, dorsal view; 5*g*, lateral view; 5*h*, apical view; 5*i*, front view,—these latter five figures enlarged. Fig. 6, specimen with broken-off margins and wings, thus showing the marginal ridges, from the *Cephalopoda*-bed of Jabi: 6*a*, dorsal view; 6*b*, lateral view,—both natural size; 6*c* & *d*, the same two views enlarged.

Geol. Surv of India

ALT-RANGE FOSSI

Pl. LXXV

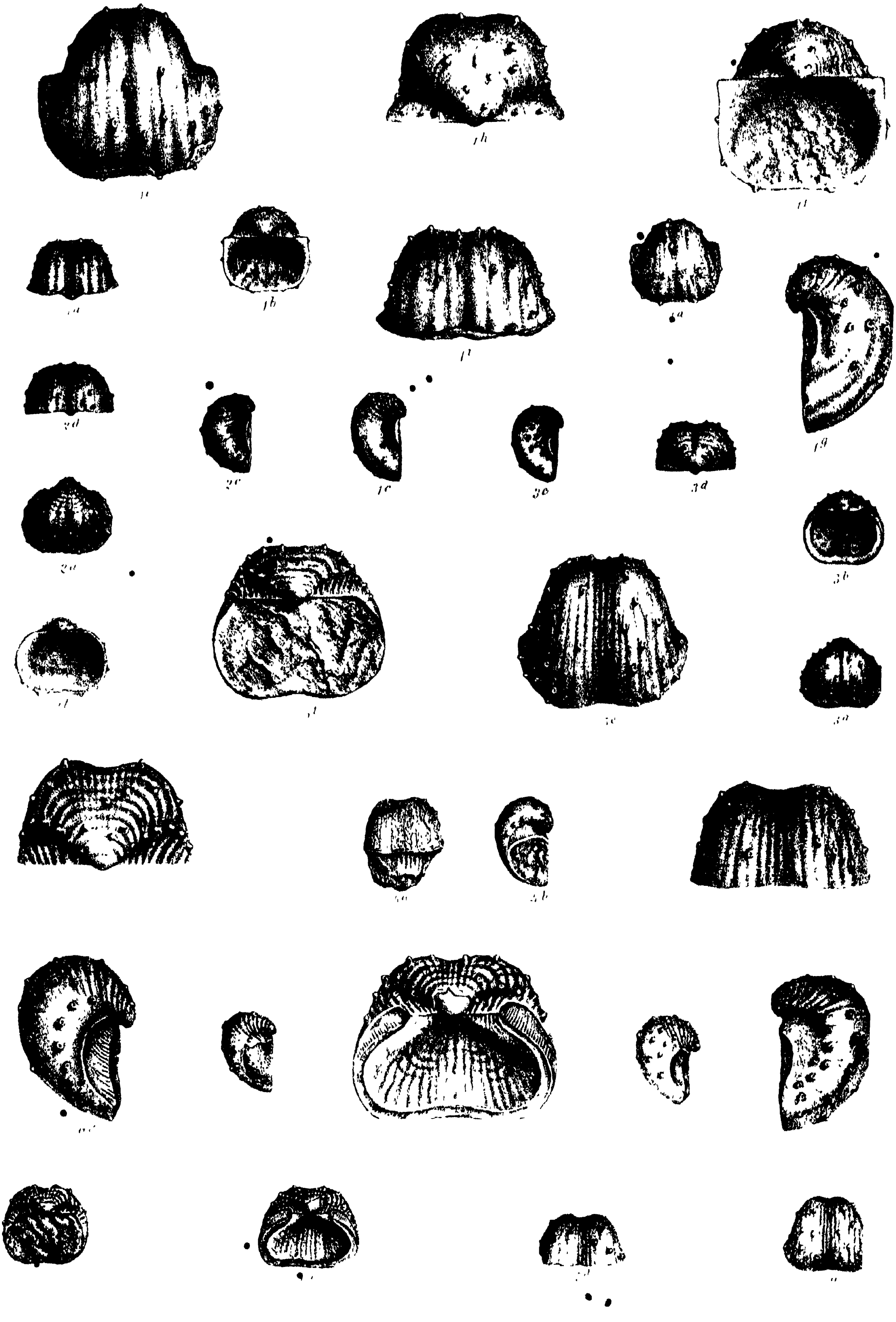


PLATE LXXVIII.

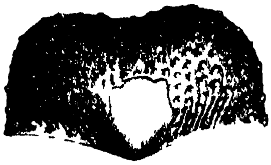
PRODUCTUS-LIMESTONE.

Figure 1. **Marginifera echinata**, Waagen, n. gen. et sp., p. 727. Piece of yellowish-white sandstone with several specimens of the ventral valve of this species,—all without wings; 1*a* & *b*, two different views, from the lower Productus-limestone of Bhal, the other figures, one of the specimens enlarged; 1*c*, ventral view; 1*d*, lateral view; 1*e*, apical view; 1*f*, front view, the shell partly preserved, but the wings broken off. (The dorsal valve, see Pl. LXXV, figs. 7, 8.)

2, 3. **Marginifera excavata**, Waagen, n. gen. et sp., p. 715. Two specimens with preserved shell from the lower Productus-limestone of the Nílawán. Fig. 2*a*, *b*, *c*, *d*, four views of a specimen with broken margins, natural size; 2*e*, ventral view; 2*f*, dorsal view; 2*g*, lateral view; 2*h*, apical view; 2*e*, front view,—these latter five figures enlarged. Fig. 3, other specimen with preserved spines; 3*a*, ventral view; 3*b*, lateral view,—both natural

4, 5. **Marginifera transversa**, Waagen, n. gen. et sp., p. 725. Two specimens, from the *Chonetes*-bed of the lower Productus-limestone of Amb. Fig. 4 specimen with preserved shell, the surface layer partly destroyed; 4*a*, front view; 4*b*, apical view; 4*c*, lateral view,—all natural size; 4*d*, ventral view; 4*e*, front view; 4*f*, lateral view,—in these two figures the spines too short and thick; 4*g*, apical view,—these latter four figures enlarged. Fig. 5, other specimen with preserved shell and considerably flattened apical region; 5*a*, ventral view; 5*b*, front view; 5*c*, lateral view,—all natural size.

SALT-RANGE FOSSILS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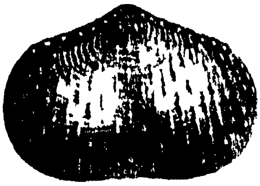
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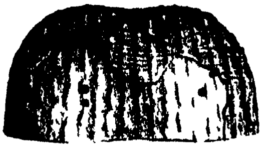
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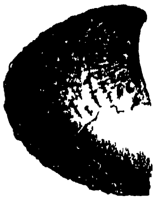
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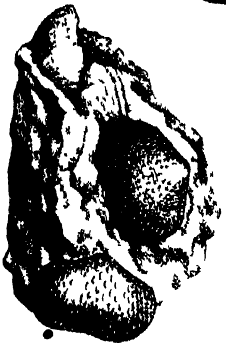
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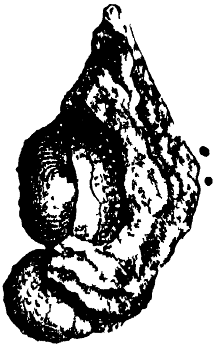
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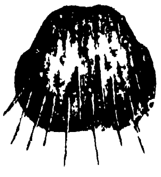
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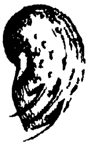
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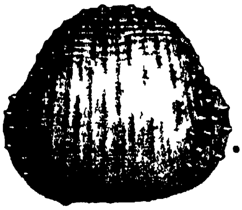
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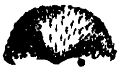
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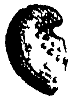
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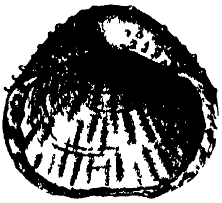
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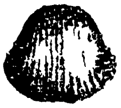
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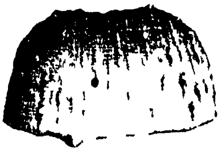
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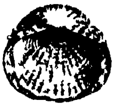
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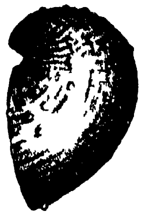
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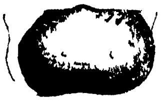
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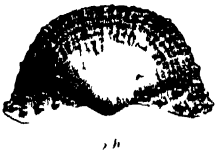
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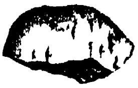
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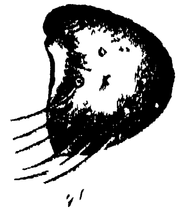
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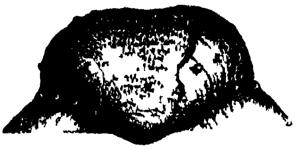
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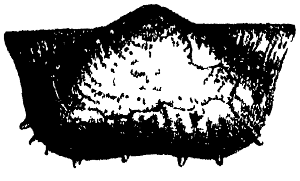
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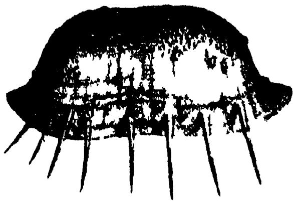
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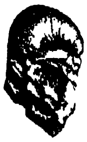
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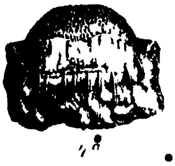
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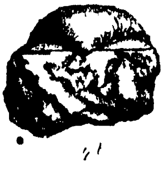
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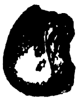
5e

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PLATE LXXIX.

PRODUCTUS-LIMESTONE.

1—2. PRODUCTUS OPUNTIA, Waagen, n. sp., p. 707. Fig. 1, largest specimen known to me, with preserved shell, from the *Cephalopoda*-bed of the upper Productus-limestone of Jabi; *1a*, ventral view; *1b*, dorsal view; *1c*, lateral view; *1d*, front view; *1e*, apical view,—all natural size; *1f*, ventral view; *1g*, dorsal view; *1h*, lateral view; *1i*, front view; *1k*, apical view,—these latter five figures enlarged. Fig. 2, other specimen with preserved shell from the *Cephalopoda*-bed of the upper Productus-limestone of Chidru; *2a*, ventral view; *2b*, dorsal view; *2c*, lateral view; *2d*, front view,—all natural size; *2e*, ventral view; *2f*, dorsal view; *2g*, lateral view; *2h*, front view; *2i*, apical view,—these latter five figures enlarged.

3—6. PRODUCTUS ASPERULUS, Waagen, n. sp., p. 693. Fig. 3, tolerably complete specimen with preserved shell from the *Cephalopoda*-bed of the upper Productus-limestone of Jabi; *3a*, ventral view; *3b*, dorsal view, *3c*, lateral view; *3d*, front view; *3e*, apical view,—all natural size; *3f*, ventral view; *3g*, dorsal view; *3h*, lateral view,—these latter three figures enlarged. Fig. 4, specimen much deformed by pressure from the *Cephalopoda*-bed of the upper Productus-limestone of Chidru; *4a*, ventral view; *4b*, lateral view,—both natural size. Fig. 5, internal side of a dorsal valve from the *Cephalopoda*-bed of Jabi. Fig. 6, internal side of a fragmentary dorsal valve from the middle Productus-limestone of Káfirkot.

SALT-RANGE FOSSILS

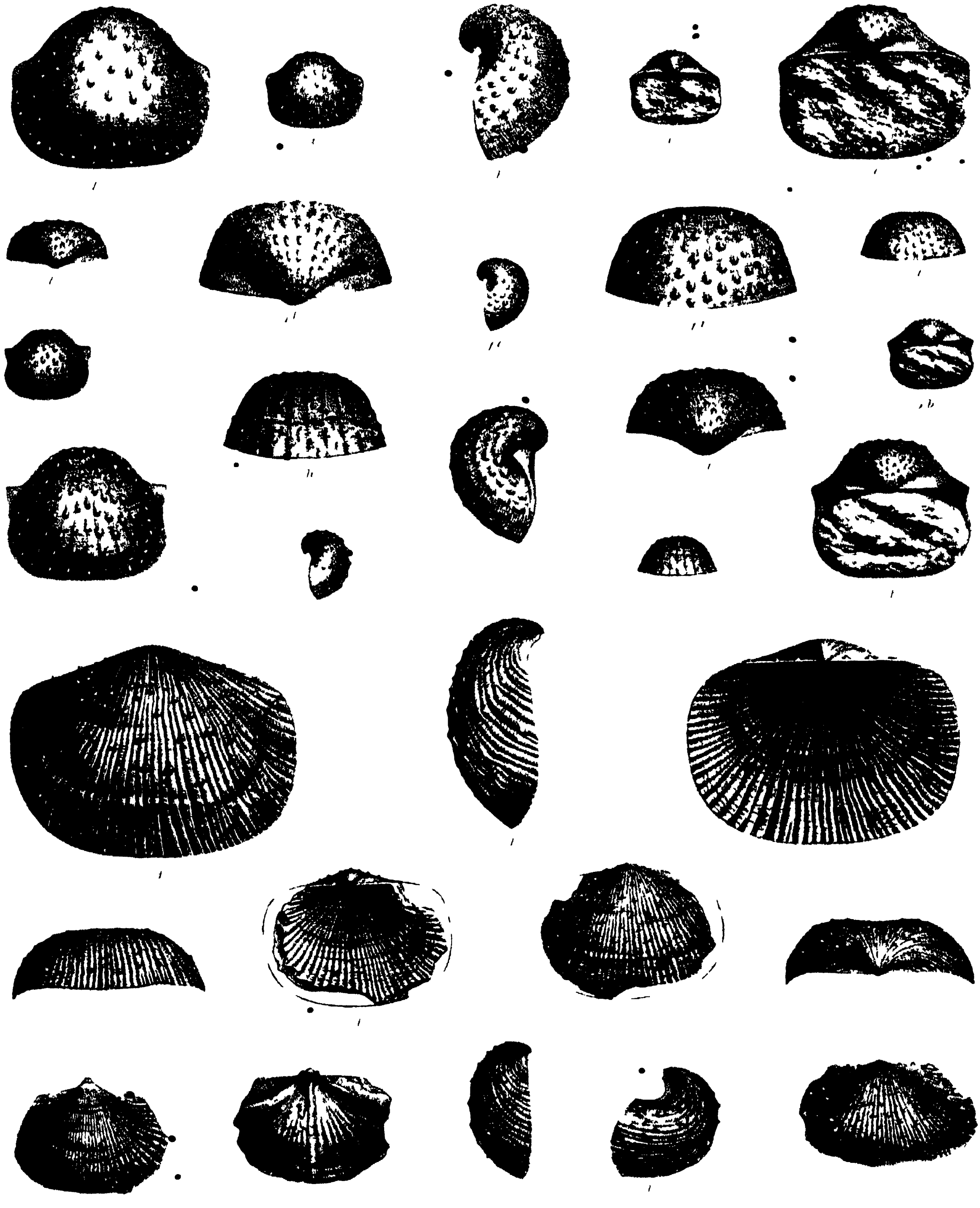

PLATE LXXX.

PRODUCTUS-LIMESTONE.

Figures 1—3. **Productus tumidus**, Waagen, n. sp., p. 708. Fig. 1, well-preserved specimens from the middle Productus-limestone of Morah; 1*a*, ventral view; 1*b*, dorsal view; 1*c*, apical view; 1*d*, front view; 1*e*, lateral view,—all natural size; 1*f*, ventral view; 1*g*, lateral view,—these latter two figures enlarged. Fig. 2, middle-sized specimen, the surface layer of the shell for the greater part destroyed, from the middle Productus-limestone on the road between Vurcha and Uchâli; 2*a*, ventral view; 2*b*, lateral view; 2*c*, apical view; 2*d*, front view,—all natural size. Fig. 3, small specimen from the *Cephalopoda*-bed of the upper Productus-limestone of Jabi; 3*a*, dorsal view; 3*b*, ventral view; 3*c*, lateral view; 3*d*, apical view; 3*e*, front view,—all natural size.

4. **Productus mytiloides**, Waagen, n. sp., p. 711. Specimen with both valves, the ventral one being partly broken and exposing the impression of the dorsal valve to view, from the *Cephalopoda*-bed of the upper Productus-limestone of Jabi; 4*a*, ventral view; 4*b*, lateral view; 4*c*, apical part, dorsal view,—all natural size; 4*d*, portion of the surface of the ventral valve enlarged six times.

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SALT-RANGE FOSSILS

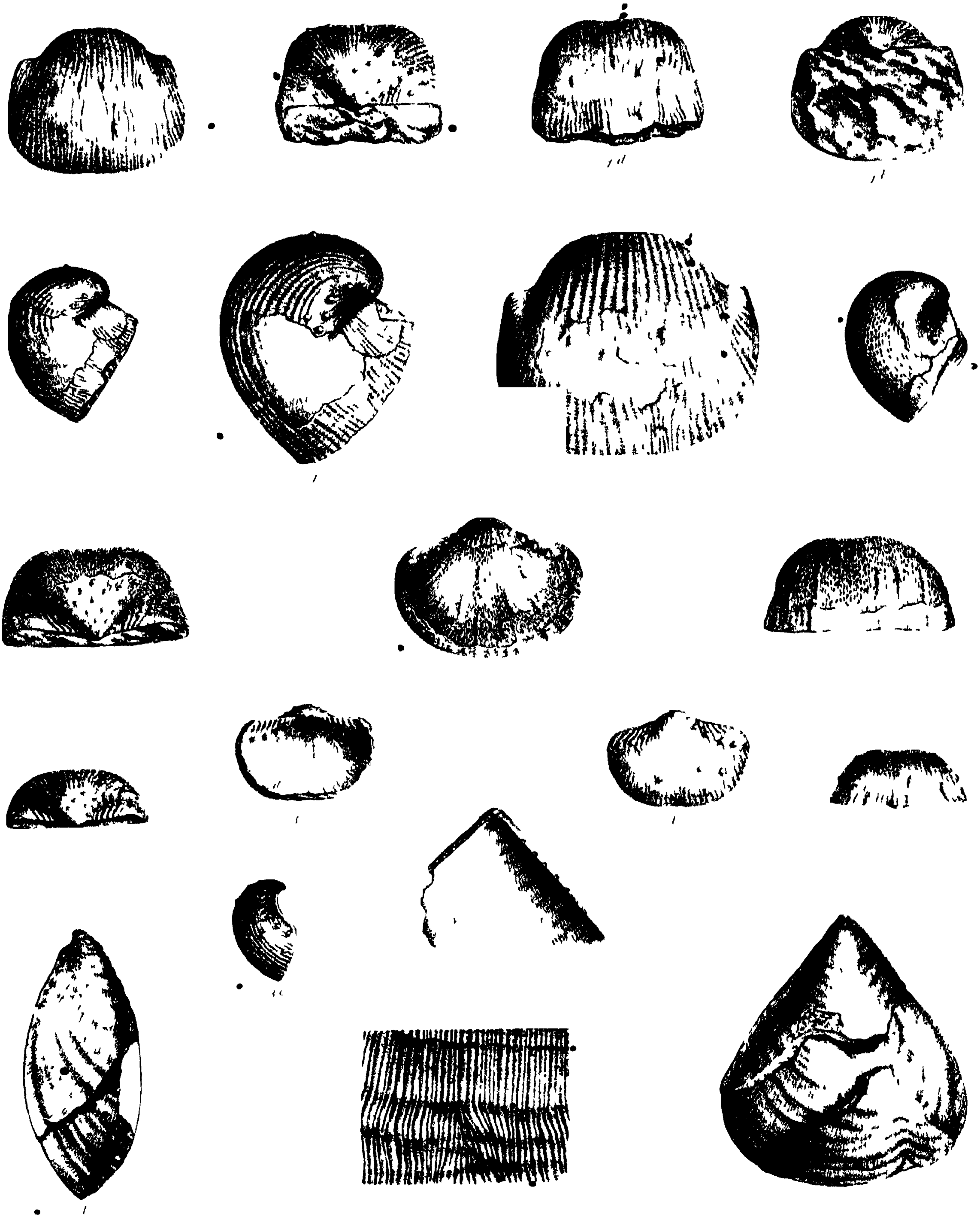

PLATE LXXXI.

PRODUCTUS-LIMESTONE.

Figures 1—2. PRODUCTUS COMPRESSUS, Waagen, n. sp., p. 710. Fig. 1, specimens with preserved shell from the middle Productus-limestone of Morah; 1*a*, ventral view; 1*b*, view from the left; 1*c*, view from the right side,—all natural size; 1*d*, portion of the surface of the ventral valve enlarged five times. Fig. 2, somewhat differently shaped specimen from the middle Productus-limestone of Vurcha; 2*a*, ventral view; 2*b*, view from the right; 2*c*, view from the left,—all natural size.

3—8. CHONETELLA NASUTA, Waagen, n. gen. et sp., p. 658. Figs. 3—5, three specimens from the *Cephalopoda*-bed of the upper Productus-limestone of Jabi,—all three internal sides of dorsal valves; 3*a*, *b*, natural size; 3*c*, *d*, 4 and 5, enlarged. Fig. 6, specimen with preserved shell, the surface layer partly destroyed, from the base of the upper Productus-limestone west of Khura; 6*a*, dorsal view, natural size; 6*b*, ventral view; 6*c*, dorsal view; 6*d*, lateral view,—these three figures enlarged. Fig. 7, specimen from the same bed and locality as the preceding; 7*a*, ventral view; 7*b*, lateral view; 7*c*, apical view,—all three natural size; 7*d*, ventral view, enlarged. Fig. 8, specimen from the *Cephalopoda*-bed of Chidru; 8*a*, ventral view; 8*b*, front view; 8*c*, lateral view,—all natural size; 8*d*, ventral view; 8*e*, apical view,—these latter two figures enlarged.

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Pl. LXXXI

SALT-RANGE FOSSILS